JACQUES, WHITFORD & ASSOCIATES LIMITED

CONSULTING ENGINEERS
AND SCIENTISTS

ENERGY, MINES AND RESOURCES CANADA

CANMET

ALKALI-AGGREGATE REACTIVITY

YEAR END REPORT

MARCH 31, 1990

PROJECT NO. 4132

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PROJECT NO. 4132

REPORT TO

ENERGY, MINES AND RESOURCES CANADA
CANMET

CONTRACT SERIAL NO. 69157-01-SQ
CONTRACT REQUISITION NO. 23440-6-9157
CONTRACT: Jacques Whitford & Assoc. Ltd.

ALKALI-AGGREGATE REACTIVITY IN NOVA SCOTIA

YEAR END REPORT

MICROMEDIA

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Jacques, Whitford and Associates Limited
March 31, 1990

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Whitford and
Associates Limited

Consulting Engineers
and Scientists

March 26, 1990
Project No. 4132

Energy, Mines and Resources Canada
CANMET, Mineral Science Laboratory
405 Rochester Street
Ottawa, Ontario
K1A 0G1

Attention: Dr. James Soles

Dear Sir:

Re: Alkali-Aggregate Reactivity in Nova Scotia

Attached is our Year End Report for the above project. The report presents all of the expansion data obtained to date and the results of the petrographic analysis performed on selected expansive concrete prisms and mortar bars.

If you have any questions regarding this report, please contact us at your convenience.

Yours very truly,

JACQUES, WHITFORD & ASSOCIATES LTD.

Wilbert S. Langley, M.Eng., P.Eng.

WSL/lb

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1.0 INTRODUCTION

This report presents the data obtained throughout year three of the study of the alkali reactivity of concrete aggregate in Nova Scotia. The first two years of the study consisted of the following study areas:

1 - Review existing data.
2 - Examine and sample concrete from existing structures.
3 - Identify types of aggregates used in concrete showing distress from alkali aggregate reactivity.
4 - Sample and perform petrographic analysis on existing aggregate sources to determine if these sources are presently utilizing similar rock types as those found in expansive concrete.
5 - Test existing aggregate sources to determine expansive potential and identify expansive rock types from tests.

Having carried out the above phases of the study, several aggregate sources were identified as using aggregates which may cause deleterious expansions when used in concrete exposed to wet conditions. The rock types consisted of meta-sediments from the Meguma Group which are wide spread throughout eastern and southern Nova Scotia and widely used as quarried aggregate throughout Halifax County. This use also coincided with the majority of structures showing distress from alkali aggregate reactivity. These meta-sediments were predominantly comprised of meta-argillite, meta-greywacke and spotted slate all of which have undergone low grade regional metamorphism.

The work program for year three was to carry out the following study areas:

1 - Continue long term monitoring of selected aggregate sources.
2 - Perform petrographic analysis on samples which have exceeded expansion limits and samples using potentially reactive aggregate types that have not expanded to determine the characteristics of the reaction.
3 - Examine stabilization methods to control expansions.

2.0 MONITORING OF TEST SPECIMENS

2.1 Concrete Prisms

Coarse aggregate sources were tested using Method CSA23.2-14A, Clause 2.4 in which concrete prisms are stored at 38°C and 100 %Rh, the alkali content of the cement is increased to 1.25% as Na_2O. Expansion limits for the different exposure classes at 365 days are 0.040% for exposure class A,B and C, and 0.075% for exposure class D.

Fourteen aggregate sources were tested using this method including two reference aggregates used as laboratory standards. Of the samples tested, the following sources exceeded the recommended limits:

SUMMARY OF CONCRETE PRISM EXPANSIONS

Source (Quarry)	Expansion %	Age (days)
Rocky Lake	0.094	365
	0.107	617
Steed & Evans	0.128	365
	0.148	617
Conrads	0.135	365
	0.153	533
Spratt Lab Standard	0.199	365
	0.207	617

The three quarries are located in the Halifax/Dartmouth area within the Goldenville Formation. Petrographic analysis of these aggregates correspond to the reactive materials observed in the specimens examined from deteriorated structures. Detailed petrographic analysis on test samples from Rocky Lake Quarry and Conrads Quarry were carried out by the Research and Productivity Council in Fredericton New Brunswick and results are presented in Appendix 9.

Additional petrographic analysis were also carried out for aggregates from Gateway Quarry, South Shore Sand & Gravel and Yarmouth Concrete & Gravel. These sources did not exceed the recommended expansion limits yet had a high percentage of potentially reactive meta-sediments. Results of these analysis are also presented in Appendix 9 and indicate that the potentially reactive constituents have undergone a higher degree of metamorphic recrystallization. Gateway Quarry and South Shore Sand & Gravel are both located directly on a contact between the granite and Meguma group. The metamorphic grade in the Yarmouth area may also be the reason the glacial material used as aggregate does not cause expansions.

Expansion data for all of the concrete prism tests is presented in Appendix 1.

2.2 Zero Slump Concrete Mixes

In conjunction with the accelerated concrete prism tests, additional specimens were fabricated using a lower water/cement ratio to determine the affect. These test results are presented in Appendix 2. Sources chosen for this mix design are shown on the following table which presents the 1 year results and the long term monitoring to date:

SUMMARY OF ZERO SLUMP CONCRETE EXPANSION

Aggregate Source	Expansion %	Age (days)
Rocky Lake Quarry	0.065	365
	0.073	533
Conrads Quarry	0.056	365
	0.061	533
Gateway Quarry	0.020	365
	0.029	533

The results to date generally follow the same trend as the standard mixes although the initial shrinkage experienced in the standard mixes was eliminated.

2.3 ASTM C227, Mortar Bar Method

This test method was used to evaluate the main sources of fine aggregate throughout the province. The mortar bars were fabricated using the normal alkali content of the Brookfield Type 10 cement which is 0.89% as Na_2O. The data obtained to date is presented in Appendix 3 at the back of the report. The sources tested include the following:

SUMMARY OF MORTAR BAR EXPANSIONS

	EXPANSION %		
Aggregate Source	3 Months	6 Months	12 Months
Meadows Pit	0.017	0.019	0.020
Orangedale Sand	0.009	0.012	0.011
Barneys River	0.012	0.008	0.016
Shubenacadie	0.013	0.011	0.016
Silica Sand	0.018	0.019	0.019
Yarmouth Conc.&Grav.	0.007	0.008	0.008
Maurices Pit	0.009	0.007	0.014

Coldbrook	0.016	0.014	0.018
Spratt Reference	0.014	0.017	0.019
LIMITS -	**0.05%**	**0.1%**	

The samples tested including the reactive laboratory standard did not exceed the limits. The alkali content of 0.89% did not accelerate the reaction to the point where the lab standard exceeded the limits, therefore additional mixes were performed on selected sources and the alkali content was increased to 1.25% as Na_2O. The data for the additional mixes is presented in Appendix 4 and summarized below.

	EXPANSION %	
Aggregate Source	3 Months	6 Months
Meadows Pit	0.010	0.009
Orangedale Sand	0.012	0.014
Barneys River	0.007	0.010
Yarmouth Conc.&Grav.	0.008	0.010
Coldbrook	0.011	0.010
Spratt Reference	0.054	0.058

Using a higher alkali content accelerated Spratts aggregate to beyond the 0.05% limit for three months, the remainder of the sands tested fell well below this limit.

2.4 High Temperature Tests

This test follows the procedure suggested by the Cement-Aggregate Sub-Committee of CSA-A5 (cement), in which mortar bars are immersed in a 1M solution of Sodium Hydroxide. Expansion measurements are taken on a daily basis up to 14 days. Tests have been performed on quarried aggregate sources and fine aggregate sources. The data is presented in Appendix 5 and the following table summarizes the results:

AGGREGATE SOURCE	EXPANSION @ 14DAYS
Meadows Sand	0.319
Orangedale Sand	0.190
Barneys River Sand	0.307
Folly Lake Sand	0.187
Shubenacadie Sand	0.161
Yarmouth Sand	0.345
Coldbrook Sand	0.178
Maurices Sand	0.124
Silica Sand	0.014
Porcupine Mountain Diabase	0.093
Conrads Quarry Crusher Fines	0.304
Rocky Lake Quarry Crusher Fines	0.235
Gateway Quarry Crusher Fines	0.156
Steed & Evans Quarry Crusher Fines	0.322
South Shore Crusher Fines	0.284
North Mountain Crusher Fines	0.070
Spratt Reference Aggregate	0.377

The results of these tests on quarried samples generally agree with the findings from the accelerated concrete prism tests, however the relatively high expansions of several of the sand sources would suggest that further work is required to determine the reaction mechanism involved in the materials particularly with respect to the low expansions observed in the mortar bar test ASTM C227. Petrographic analyses on sand sources from Meadows, Barneys River and Yarmouth are presented in RPC's report in Appendix 9 and indicate that metasediments appear to be the reactive constituent.

3.0 FLY ASH STABILIZATION

Fly ash produced at the Lingan Generating station in Cape Breton has been used in concrete throughout Nova Scotia since 1985, primarily for its economic benefits. The use of this fly ash has been incorporated into this study to determine its effectiveness in controlling expansions from reactive aggregates.

The effectiveness was evaluated using the High Temperature Test Method and the Accelerated Concrete Prism Test. Specimens were fabricated using standard control mixes with no fly ash, and mixes with replacement levels of cement with 15, 30 and 45% fly ash.

Data obtained for the High Temperature Test is presented in Appendix 6 and is summarized in the following table:

EXPANSION OF MORTAR BARS INCORPORATING FLY ASH

		% FLY ASH REPLACEMENT		
SOURCE	CONTROL	15%	30%	45%
Rocky Lake	0.330	0.171	0.043	0.018
Conrads	0.223	0.128	0.032	0.008
Gateway	0.189	0.153	0.057	0.023

Current suggested limits for potentially reactive aggregates using this test method as proposed by the CSA Subcommittee on Alkali Aggregate Reactions is 0.15%. This would suggest that replacement levels of 20% or greater would prevent deleterious expansions.

Two sources were tested using the accelerated concrete prism test to determine the effectiveness of the Lingan ash and include Rocky Lake Quarry and Conrads Quarry. Resonant

frequency was measured in conjunction with the expansion measurements to show the relative degree of deterioration of the various mixes. The data is presented in Appendix 7 and is summarized on the following table.

EXPANSION OF CONCRETE PRISMS INCORPORATING FLY ASH

	% FLY ASH REPLACEMENT			
SOURCE	CONTROL	15%	30%	45%
Rocky Lake	0.065	0.005	-0.008	-0.005
Conrads	0.110	0.007	0.003	0.003

Expansion values at 1 year

Using an expansion limit of 0.04 % at 1 year would indicate that replacement levels of greater than 15% could be acceptable.

The effect of the expansion of the concrete can be clearly seen in the resonant frequency values taken over time. The mixes incorporating fly ash show no significant decrease in the resonant frequency whereas the control mixes show a 5 to 8 percent decrease over a 1 year period. The decrease in the resonant frequency coincides with the increase in expansion of the prisms.

4.0 EXPANSION VERSES PERCENT REACTIVE AGGREGATE

Test mixes were carried out using various levels of known reactive meta-greywacke in mortar bars. The constituents consisted of crusher fines from Rocky Lake Quarry and non-reactive silica sand. The test procedure was that used for the High Temperature Test. Results are presented in Appendix 8 and show that an increase in the percentage of reactive aggregate resulted in an increase in expansion at all levels and a pessimum effect did not exist for this type of

material. The results also suggest that levels as low as 20 percent reactive aggregate can still induce significant expansions.

We trust this is the information you require at this time. If you have any comments concerning the contents of this report please do not hesitate to contact us at your convenience.

Respectfully submitted,

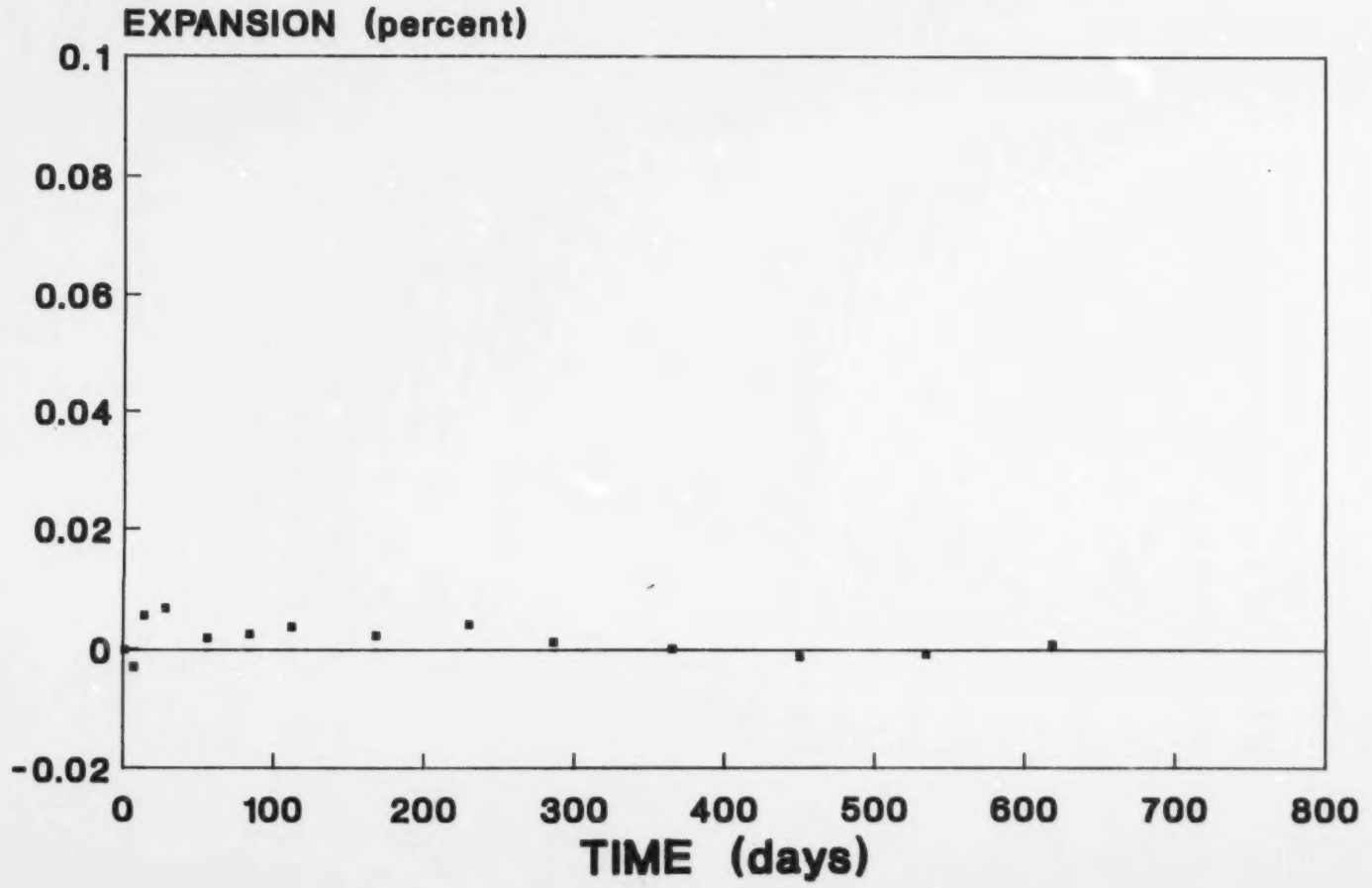
JACQUES, WHITFORD & ASSOCIATES LIMITED

Greg MacNeill, P. Eng.

APPENDIX 1

ACCELERATED CONCRETE PRISM TEST

Municipal (Meadows)



ACCELERATED CONCRETE PRISM EXPANSION TEST DATA

TYPE AND SOURCE OF AGGREGATES : Municipal (Meadows)

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-04-07

STARTING DATE OF TEST : 88-04-08

BATCH QUANTITIES:

CEMENT (kg) — - 13.95
FLY ASH (kg) - - 0
WATER (kg) — - 8.49
STONE (kg) — - 47.43
SAND (kg) — - 38.0

PROPERTIES OF MIX:

SLUMP (mm) —— 80
AIR % ———— 1.9
28 DAY COMPRESSIVE
STRENGTH (MPa) — 29.8
WATER : CEMENT RATIO — 0.61

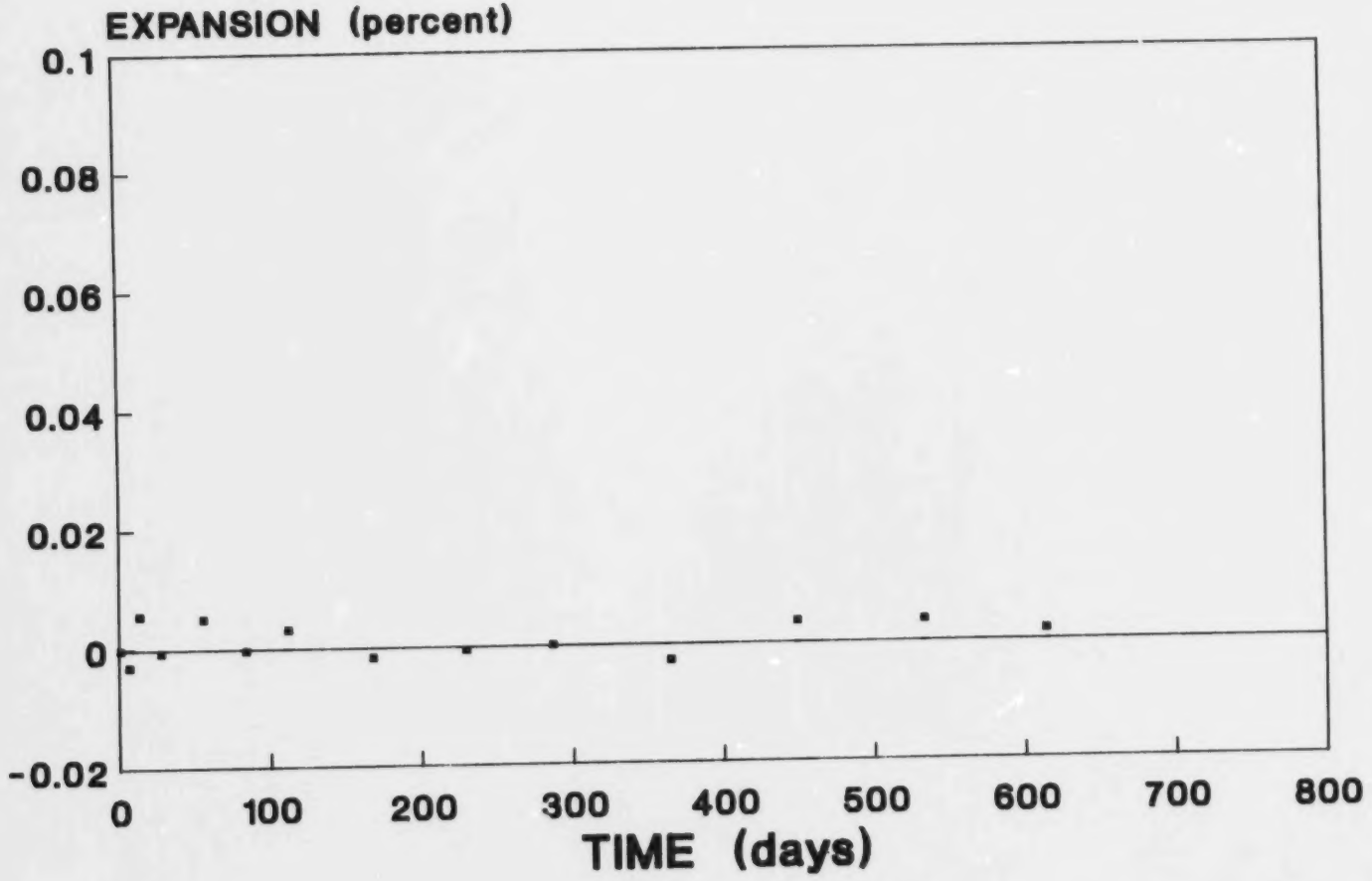
NaOH ADDED TO MIX WATER — 64.8 g

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	345.551	345.045	345.284

DATE (d/m/y)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION PERCENT
88-04-08	1	9.771	9.265	10.504	0	0	0	0.000	0.000	0.000	0.000
88-04-14	7	9.752	9.254	10.504	-0.019	-0.011	0	-0.005	-0.003	0.000	-0.003
88-04-21	14	9.763	9.279	10.527	0.022	0.014	0.023	0.006	0.004	0.007	0.006
88-05-05	28	9.796	9.291	10.525	0.025	0.026	0.021	0.007	0.008	0.006	0.007
88-06-02	56	9.794	9.27	10.496	0.023	0.005	-0.008	0.007	0.001	-0.002	0.002
88-06-30	84	9.789	9.274	10.504	0.018	0.009	0	0.005	0.003	0.000	0.003
88-07-28	112	9.803	9.27	10.506	0.032	0.005	0.002	0.009	0.001	0.001	0.004
88-09-22	168	9.8	9.264	10.5	0.029	-0.001	-0.004	0.008	0.000	-0.001	0.002
88-11-23	230	9.808	9.275	10.5	0.037	0.01	-0.004	0.011	0.003	-0.001	0.004
89-01-18	286	9.792	9.265	10.496	0.021	0	-0.008	0.006	0.000	-0.002	0.001
89-04-07	365	9.79	9.264	10.487	0.019	-0.001	-0.017	0.005	0.000	-0.005	0.000
89-05-30	450	9.787	9.253	10.487	0.016	-0.012	-0.017	0.005	-0.003	-0.005	-0.001
89-09-22	534	9.79	9.253	10.488	0.019	-0.012	-0.015	0.005	-0.003	-0.004	-0.001
89-12-15	618	9.798	9.256	10.493	0.027	-0.007	-0.011	0.008	-0.002	-0.003	0.001

ACCELERATED CONCRETE PRISM TEST

MacDonald Pit



ACCELERATED CONCRETE PRISM EXPANSION TEST DATA

TYPE AND SOURCE OF AGGREGATES : MacDonald Pit

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-03-22

STARTING DATE OF TEST : 88-03-23

BATCH QUANTITIES:

CEMENT (kg) — - 7.75
FLY ASH (kg) - - 0
WATER (kg) — - 4.53
STONE (kg) — - 26.35
SAND (kg) — - 20.40

PROPERTIES OF MIX:

SLUMP (mm) —— 70
AIR % ———— 1.7
28 DAY COMPRESSIVE
STRENGTH (MPa) — 31.2
WATER : CEMENT RATIO — 0.58

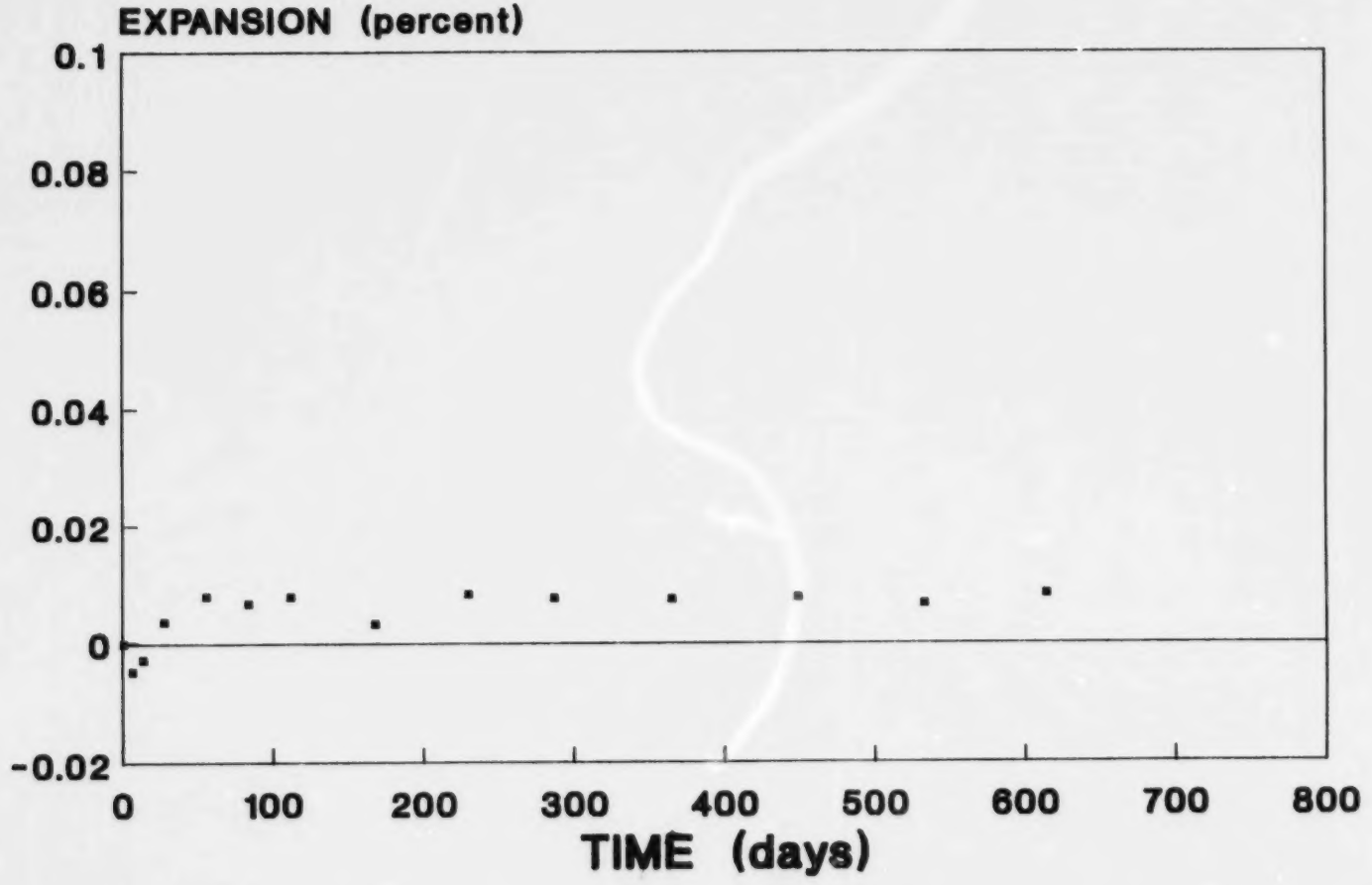
NaOH ADDED TO MIX WATER — — 35.0 g

	1	2	3
INITIAL SAMPLE LENGTH (mm)	344.691	348.04	346.438

DATE (d/m/y)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION PERCENT
88-03-23	1	16.863	18.439	18.837	0	0	0	0.000	0.000	0.000	0.000
88-03-29	7	16.863	18.423	18.823	0	-0.016	-0.014	0.000	-0.005	-0.004	-0.003
88-04-08	14	16.91	18.448	18.84	0.047	0.009	0.003	0.014	0.003	0.001	0.006
88-04-19	28	16.863	18.431	18.839	0	-0.008	0.002	0.000	-0.002	0.001	-0.001
88-05-17	56	16.883	18.459	18.85	0.02	0.02	0.013	0.006	0.006	0.004	0.005
88-06-14	84	16.86	18.439	18.837	-0.003	0	0.000	-0.001	0.000	0.000	0.000
88-07-12	112	16.875	18.451	18.846	0.012	0.012	0.009	0.003	0.003	0.003	0.003
88-09-06	168	16.852	18.433	18.836	-0.011	-0.006	-0.001	-0.003	-0.002	0.000	-0.002
88-11-08	230	16.862	18.434	18.837	-0.001	-0.005	0.000	0.000	-0.001	0.000	-0.001
89-01-04	287	16.867	18.437	18.836	0.004	-0.002	-0.001	0.001	-0.001	0.000	0.000
89-03-22	365	16.857	18.43	18.823	-0.006	-0.009	-0.014	-0.002	-0.003	-0.004	-0.003
89-05-14	448	16.882	18.445	18.849	0.019	0.006	0.012	0.006	0.002	0.003	0.004
89-06-06	533	16.883	18.444	18.849	0.02	0.005	0.012	0.006	0.001	0.003	0.004
89-11-29	614	16.883	18.432	18.841	0.02	-0.007	0.004	0.006	-0.002	0.001	0.002

ACCELERATED CONCRETE PRISM TEST

Porcupine Mountain



ACCELERATED CONCRETE PRISM EXPANSION TEST DATA

TYPE AND SOURCE OF AGGREGATES : Porcupine Mountain

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-03-22

STARTING DATE OF TEST : 88-03-23

BATCH QUANTITIES:

CEMENT (kg) — - 9.92
FLY ASH (kg) - - 0
WATER (kg) — - 6.17
STONE (kg) — - 33.73
SAND (kg) — - 27.74

PROPERTIES OF MIX:

SLUMP (mm) — 80
AIR % — 1.7
28 DAY COMPRESSIVE STRENGTH (MPa) — 31.0
WATER : CEMENT RATIO — 0.62

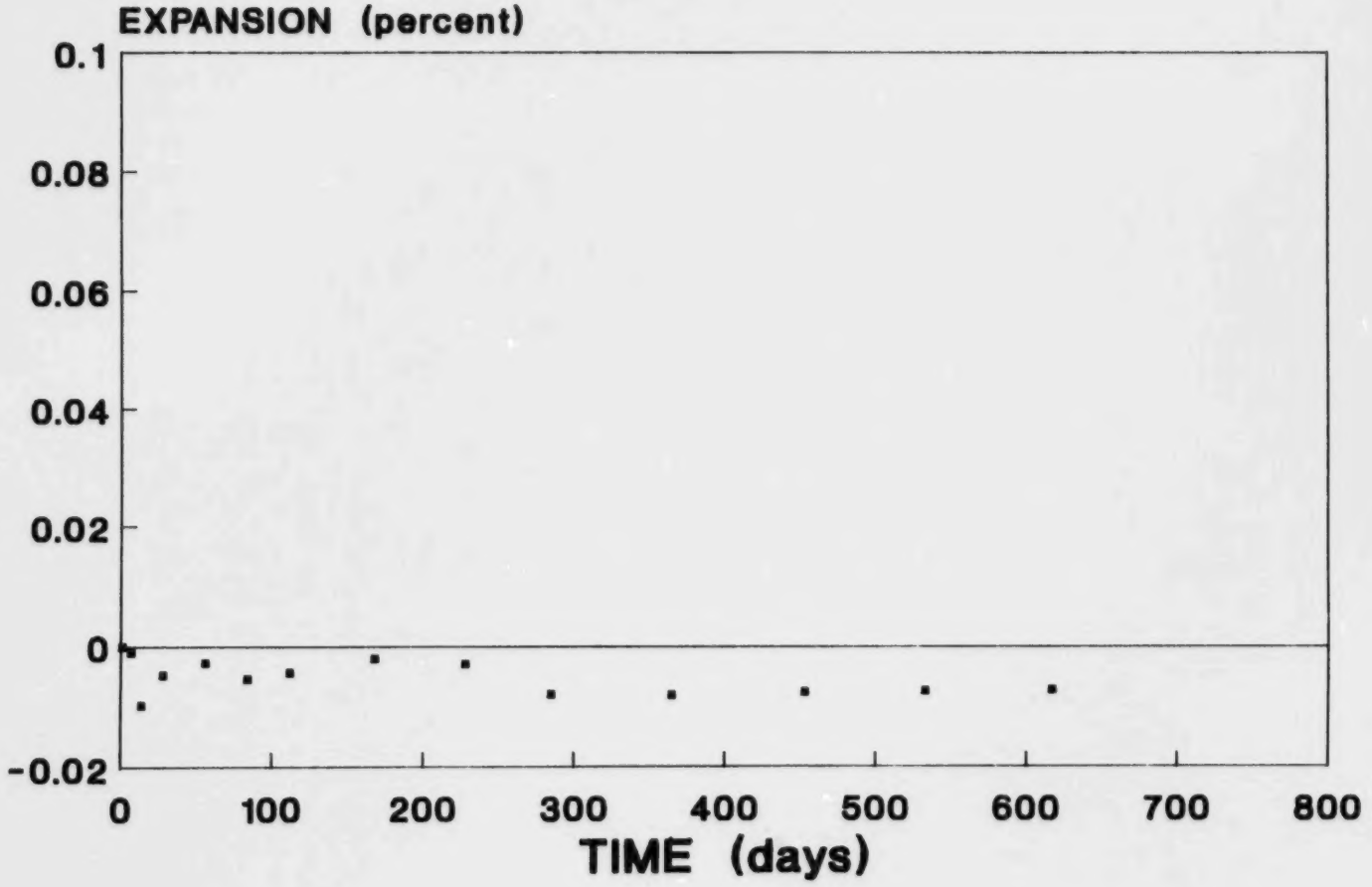
NaOH ADDED TO MIX WATER — — 46.1 g

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	349.006	348.98	348.855

DATE (d/m/y)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION PERCENT
88-03-23	1	21.405	21.379	21.254	0	0	0	0.000	0.000	0.000	0.000
88-03-29	7	21.389	21.357	21.243	-0.016	-0.022	-0.011	-0.005	-0.006	-0.003	-0.005
88-04-05	14	21.402	21.371	21.237	-0.003	-0.008	-0.017	-0.001	-0.002	-0.005	-0.003
88-04-19	28	21.428	21.394	21.255	0.023	0.015	0.001	0.007	0.004	0.000	0.004
88-05-17	56	21.44	21.411	21.271	0.035	0.032	0.017	0.010	0.009	0.005	0.008
88-06-14	84	21.435	21.403	21.271	0.03	0.024	0.017	0.009	0.007	0.005	0.007
88-07-12	112	21.442	21.405	21.274	0.037	0.026	0.02	0.011	0.007	0.006	0.008
88-09-06	168	21.431	21.379	21.262	0.026	0	0.008	0.007	0.000	0.002	0.003
88-11-08	230	21.441	21.409	21.275	0.036	0.03	0.021	0.010	0.009	0.006	0.008
89-01-04	287	21.436	21.407	21.275	0.031	0.028	0.021	0.009	0.008	0.006	0.008
89-03-22	365	21.434	21.409	21.273	0.029	0.03	0.019	0.008	0.009	0.005	0.007
89-05-14	449	21.436	21.409	21.274	0.031	0.03	0.02	0.009	0.009	0.006	0.008
89-09-06	533	21.431	21.409	21.267	0.026	0.03	0.013	0.007	0.009	0.004	0.007
89-11-29	614	21.436	21.414	21.275	0.031	0.035	0.021	0.009	0.010	0.006	0.008

ACCELERATED CONCRETE PRISM TEST

Barneys River



ACCELERATED CONCRETE PRISM EXPANSION TEST DATA

TYPE AND SOURCE OF AGGREGATES : Barneys River

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-03-17

STARTING DATE OF TEST : 88-03-18

BATCH QUANTITIES:

CEMENT (kg) — - 13.95
FLY ASH (kg) - - 0
WATER (kg) — - 6.19
STONE (kg) — - 47.43
SAND (kg) — - 37.1

PROPERTIES OF MIX:

SLUMP (mm) — 90
AIR % — 1.8
28 DAY COMPRESSIVE STRENGTH (MPa) — 27.3
WATER : CEMENT RATIO — 0.59

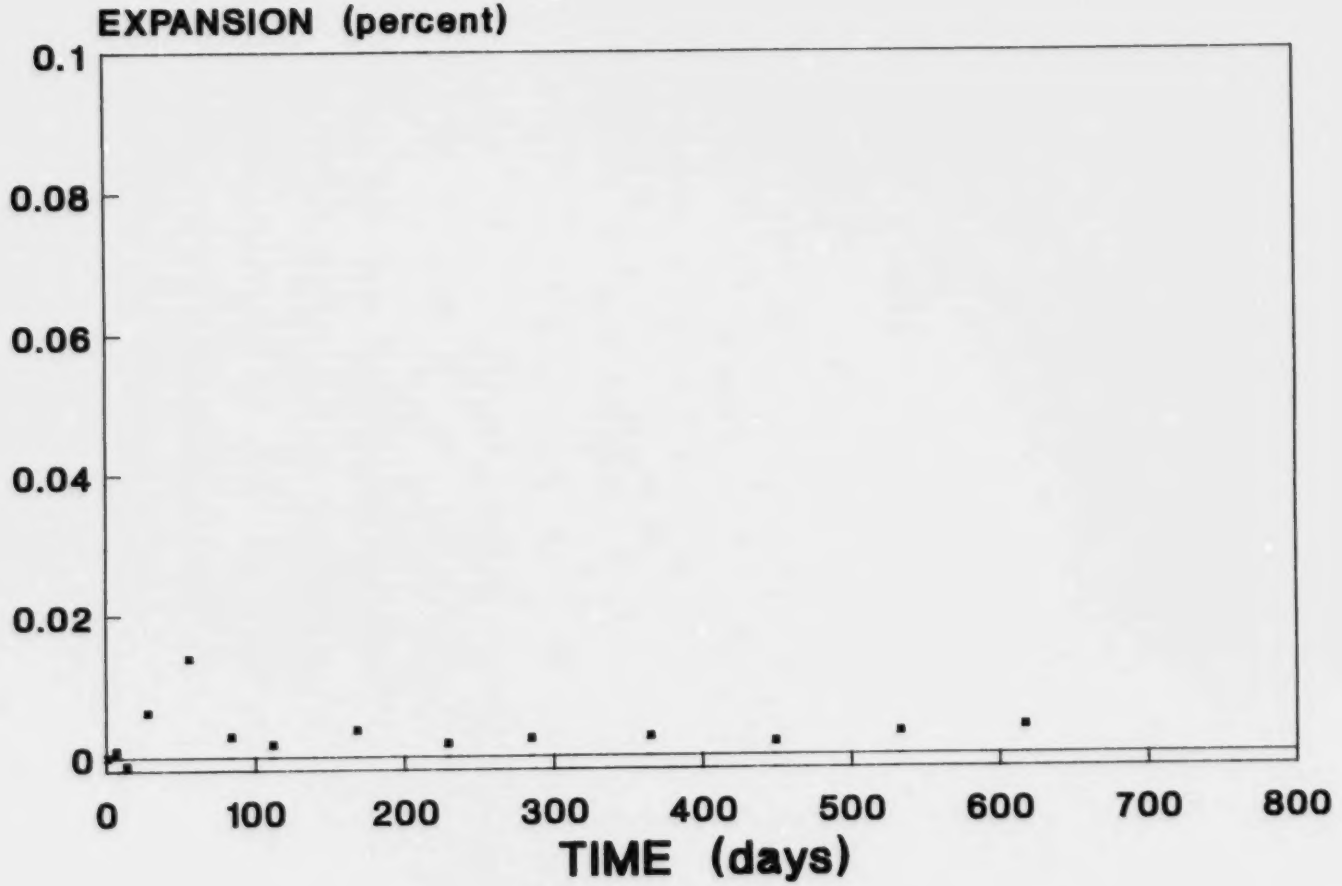
NaOH ADDED TO MIX WATER — — 64.8 g

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	349.816	349.556	347.132

DATE (d/m/y)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION PERCENT
88-03-18	1	22.215	21.956	19.531	0	0	0	0.000	0.000	0.000	0.000
88-03-24	7	22.211	21.943	19.537	-0.004	-0.012	0.006	-0.001	-0.003	0.002	-0.001
88-03-31	14	22.178	21.914	19.508	-0.037	-0.041	-0.023	-0.011	-0.012	-0.007	-0.010
88-04-14	28	22.197	21.924	19.531	-0.018	-0.031	0	-0.005	-0.009	0.000	-0.005
88-05-12	56	22.2	21.925	19.548	-0.015	-0.03	0.017	-0.004	-0.009	0.005	-0.003
88-06-09	84	22.191	21.92	19.534	-0.024	-0.036	0.003	-0.007	-0.010	0.001	-0.005
88-07-07	112	22.191	21.924	19.541	-0.024	-0.031	0.01	-0.007	-0.009	0.003	-0.004
88-09-01	168	22.196	21.93	19.554	-0.019	-0.025	0.023	-0.005	-0.007	0.007	-0.002
88-11-28	229	22.191	21.928	19.552	-0.024	-0.027	0.021	-0.007	-0.008	0.006	-0.003
88-12-28	285	22.173	21.916	19.529	-0.042	-0.039	-0.002	-0.012	-0.011	-0.001	-0.008
89-03-17	365	22.174	21.916	19.527	-0.041	-0.039	-0.004	-0.012	-0.011	-0.001	-0.008
89-06-13	453	22.175	21.915	19.532	-0.04	-0.04	0.001	-0.011	-0.011	0.000	-0.008
89-09-01	533	22.175	21.917	19.532	-0.04	-0.038	0.001	-0.011	-0.011	0.000	-0.007
89-11-24	617	22.177	21.916	19.533	-0.038	-0.039	0.002	-0.011	-0.011	0.001	-0.007

ACCELERATED CONCRETE PRISM TEST

Folly Lake Pit



ACCELERATED CONCRETE PRISM EXPANSION TEST DATA

TYPE AND SOURCE OF AGGREGATES : Folly Lake Pit

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-03-16

STARTING DATE OF TEST : 88-03-17

BATCH QUANTITIES:

CEMENT (kg) — - 13.95
FLY ASH (kg) - - 0
WATER (kg) — - 7.34
STONE (kg) — - 47.43
SAND (kg) — - 38.40

PROPERTIES OF MIX:

SLUMP (mm) —— 85
AIR % —— 2.1
28 DAY COMPRESSIVE STRENGTH (MPa) — 29.4
WATER : CEMENT RATIO — 0.53

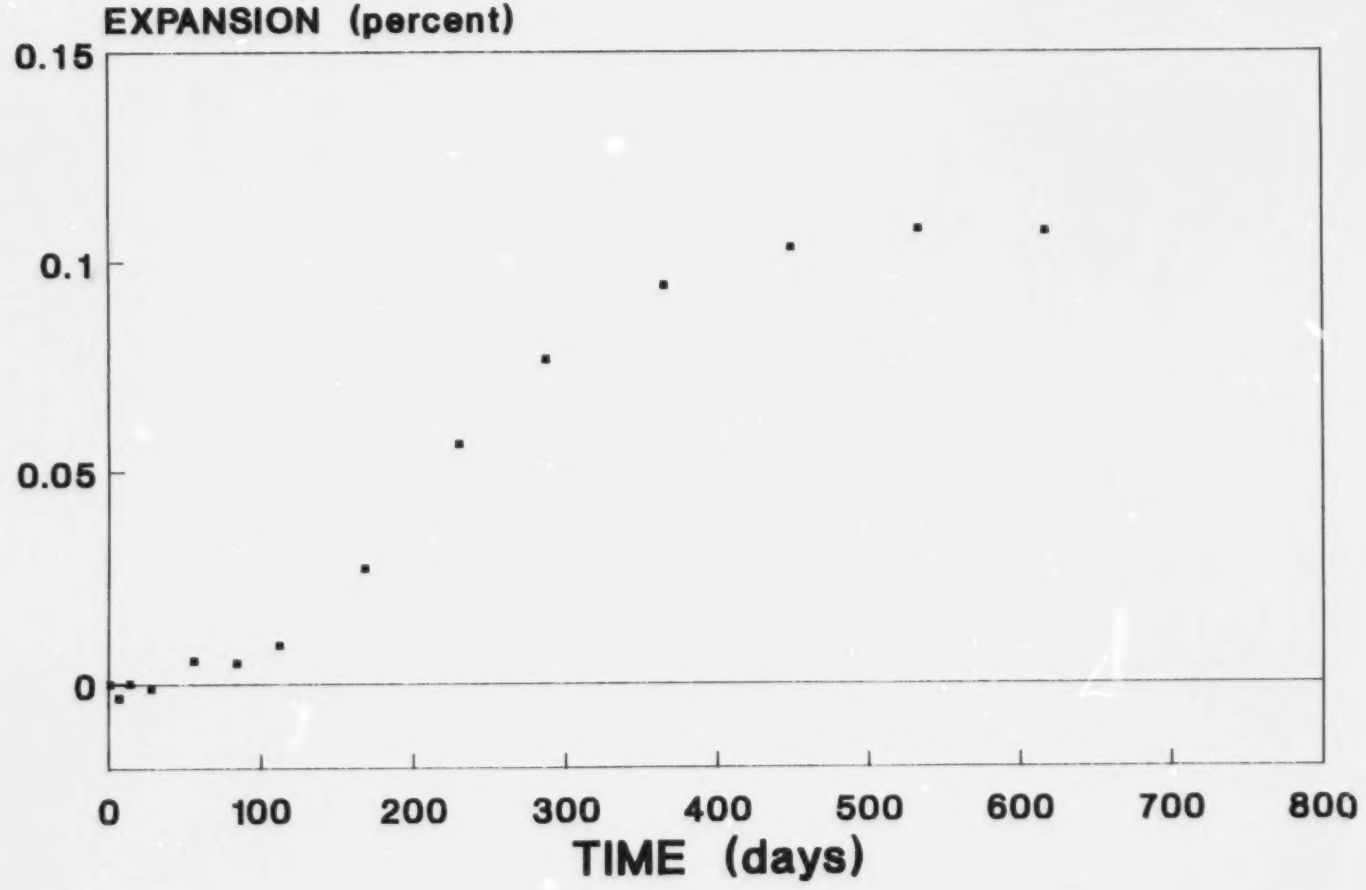
NaOH ADDED TO MIX WATER — — 64.8 g

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	345.575	350.084	347.514

DATE (d/m/y)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION PERCENT
88-03-17	1	17.974	22.483	19.913	0	0	0	0.000	0.000	0.000	0.000
88-03-23	7	17.996	22.469	19.915	0.022	-0.014	0.002	0.006	-0.004	0.001	0.001
88-03-30	14	17.972	22.467	19.918	-0.002	-0.016	0.005	-0.001	-0.005	0.001	-0.001
88-04-13	28	18.001	22.494	19.941	0.027	0.011	0.028	0.008	0.003	0.008	0.006
88-05-11	56	18.011	22.535	19.969	0.037	0.052	0.056	0.011	0.015	0.016	0.014
88-06-08	84	17.988	22.473	19.939	0.014	-0.01	0.026	0.004	-0.003	0.007	0.003
88-07-06	112	17.984	22.466	19.938	0.01	-0.017	0.025	0.003	-0.005	0.007	0.002
88-08-31	168	17.989	22.474	19.946	0.015	-0.009	0.033	0.004	-0.003	0.009	0.004
88-11-01	229	17.979	22.467	19.943	0.005	-0.016	0.03	0.001	-0.005	0.009	0.002
88-12-27	285	17.981	22.472	19.943	0.007	-0.011	0.03	0.002	-0.003	0.009	0.003
89-03-16	365	17.986	22.472	19.94	0.012	-0.011	0.027	0.003	-0.003	0.008	0.003
89-06-08	449	17.983	22.461	19.945	0.009	-0.022	0.032	0.003	-0.006	0.009	0.002
89-08-31	533	17.986	22.47	19.947	0.012	-0.013	0.034	0.003	-0.004	0.010	0.003
89-11-23	617	17.987	22.474	19.95	0.013	-0.009	0.037	0.004	-0.003	0.011	0.004

ACCELERATED CONCRETE PRISM TEST

Rocky Lake Quarry



ACCELERATED CONCRETE PRISM EXPANSION TEST DATA

TYPE AND SOURCE OF AGGREGATES : Rocky Lake Quarry

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-03-22

STARTING DATE OF TEST : 88-03-23

BATCH QUANTITIES:

CEMENT (kg) — - 13.95
FLY ASH (kg) - - 0
WATER (kg) — - 8.34
STONE (kg) — - 47.43
SAND (kg) — - 38.57

PROPERTIES OF MIX:

SLUMP (mm) — 90
AIR % — 1.6
28 DAY COMPRESSIVE STRENGTH (MPa) — 32.2
WATER : CEMENT RATIO — 0.60

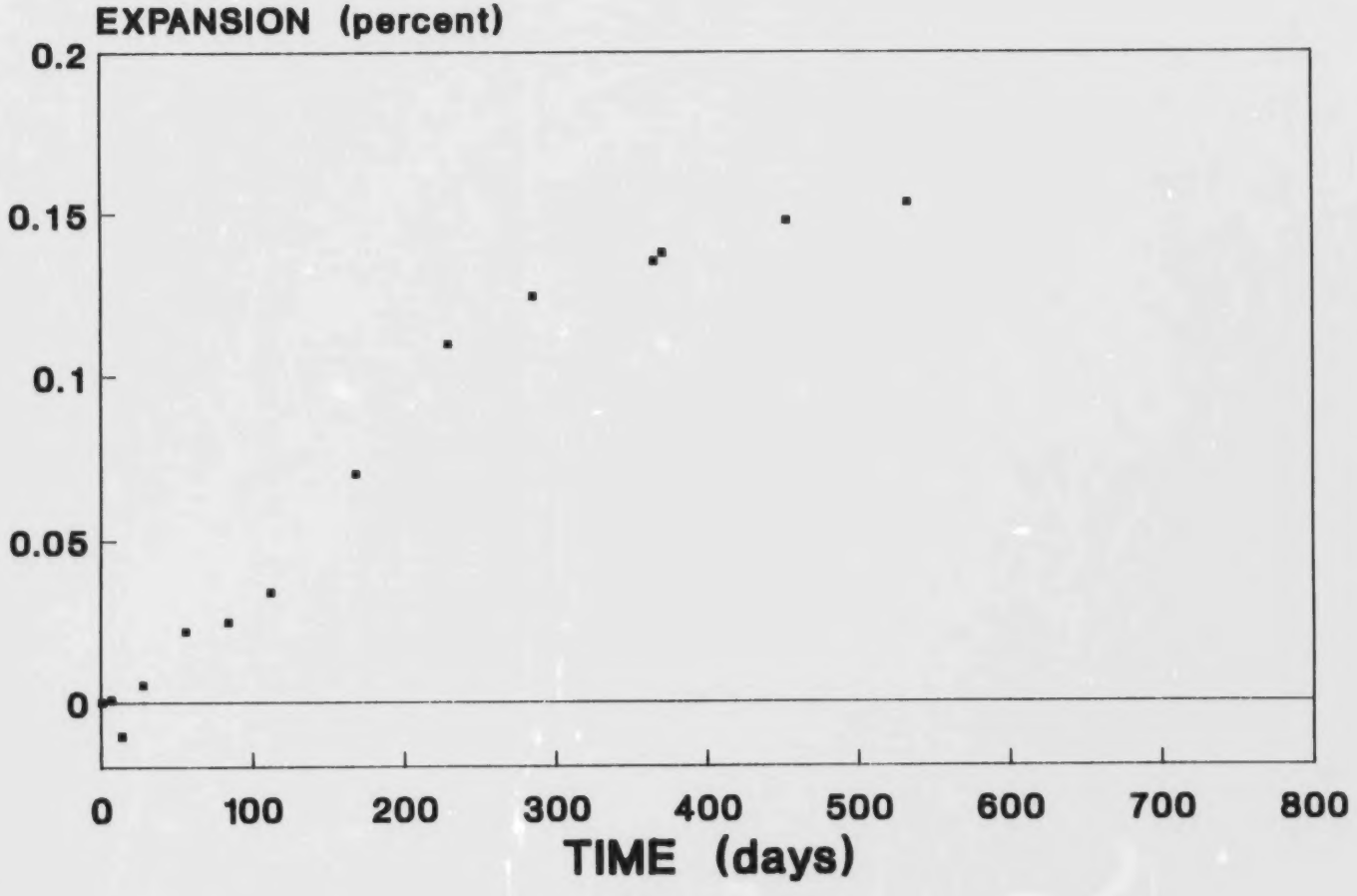
NaOH ADDED TO MIX WATER — — 64.8 g

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	347.887	346.934	344.648

DATE (d/m/y)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION PERCENT
88-03-23	1	20.286	19.333	17.047	0	0	0	0.000	0.000	0.000	0.000
88-03-29	7	20.282	19.33	17.021	-0.004	-0.003	-0.026	-0.001	-0.001	-0.008	-0.003
88-04-86	14	20.281	19.337	17.049	-0.005	0.004	0.002	-0.001	0.001	0.001	0.000
88-04-19	28	20.279	19.339	17.038	-0.007	0.006	-0.009	-0.002	0.002	-0.003	-0.001
88-05-17	56	20.302	19.341	17.08	0.016	0.008	0.033	0.005	0.002	0.010	0.005
88-06-14	84	20.305	19.338	17.074	0.019	0.005	0.027	0.005	0.001	0.008	0.005
88-07-12	112	20.316	19.352	17.093	0.03	0.019	0.046	0.009	0.005	0.013	0.009
88-09-06	168	20.371	19.421	17.157	0.085	0.088	0.11	0.024	0.025	0.032	0.027
88-11-08	230	20.486	19.486	17.284	0.199	0.152	0.237	0.057	0.044	0.069	0.057
89-01-04	287	20.546	19.533	17.383	0.26	0.2	0.336	0.075	0.058	0.097	0.077
89-03-22	365	20.607	19.59	17.449	0.321	0.257	0.402	0.092	0.074	0.117	0.094
89-06-14	449	20.636	19.635	17.47	0.35	0.302	0.423	0.101	0.087	0.123	0.103
89-09-06	533	20.647	19.646	17.493	0.361	0.313	0.446	0.104	0.090	0.129	0.108
89-03-22	617	20.645	19.644	17.491	0.359	0.311	0.444	0.103	0.090	0.129	0.107

ACCELERATED CONCRETE PRISM TEST

Conrads Quarry



APPENDIX

2

ACCELERATED CONCRETE PRISM EXPANSION TEST DATA

TYPE AND SOURCE OF AGGREGATES : Conrads Quarry

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-03-17

STARTING DATE OF TEST : 88-03-18

BATCH QUANTITIES:

CEMENT (kg) — - 13.95
FLY ASH (kg) - - 0
WATER (kg) — - 8.59
STONE (kg) — - 47.43
SAND (kg) — - 39.48
NaOH ADDED TO MIX WATER — — 64.8 g

PROPERTIES OF MIX:

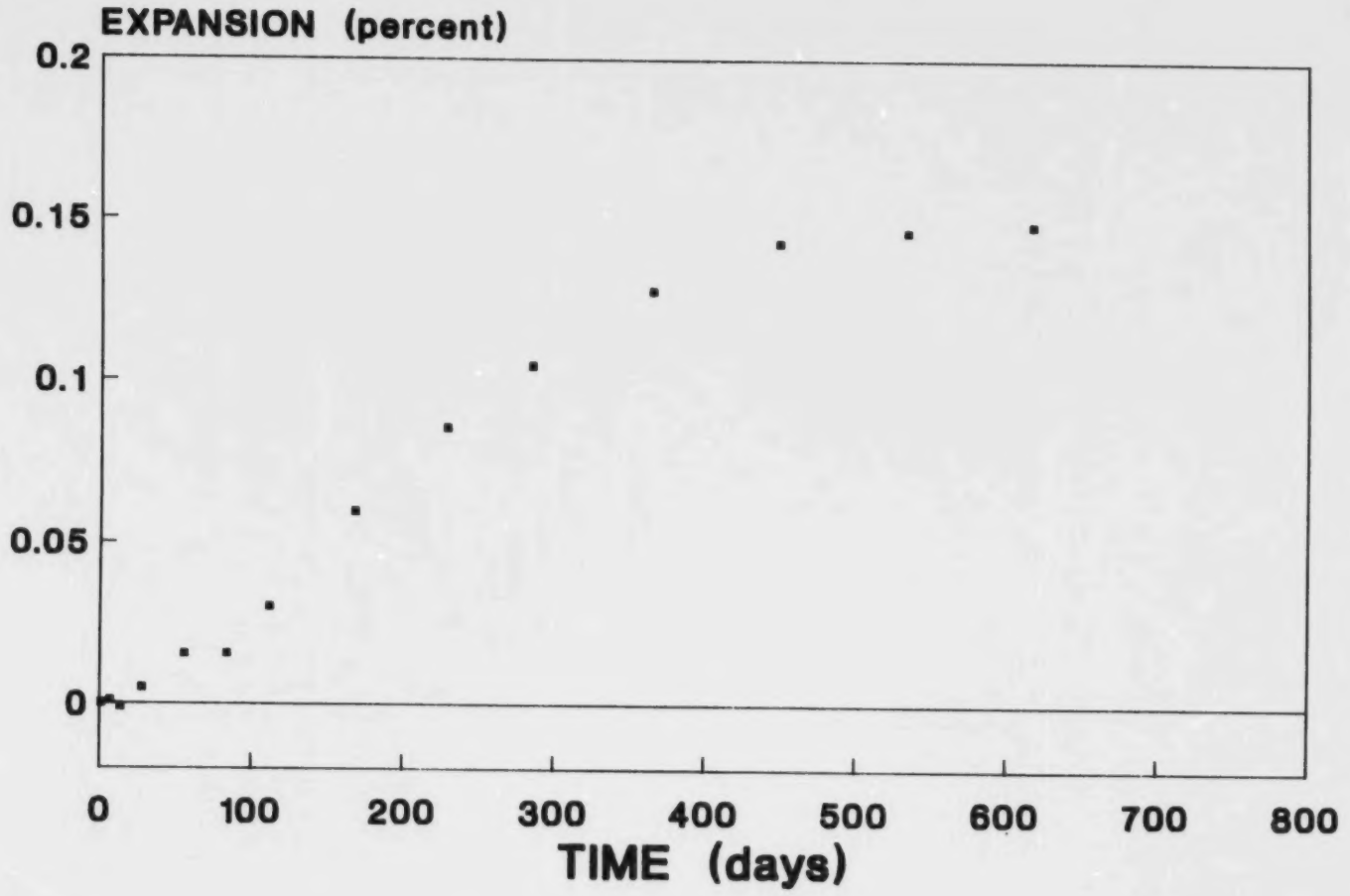
SLUMP (mm) — 80
AIR % — 1.5
28 DAY COMPRESSIVE STRENGTH (MPa) — 27.1
WATER : CEMENT RATIO — 0.62

	1	2
INITIAL SAMPLE LENGTH (mm) —	346.657	345.776

DATE (d/m/y)	AGE (days)	GAUGE READING (mm) 1	2	LENGTH CHANGE (mm) 1	2	PERCENT EXPANSION 1	2	AVERAGE EXPANSION PERCENT
88-03-18	1	19.056	18.175	0	0	0.000	0.000	0.000
88-03-24	7	19.062	18.174	0.006	-0.001	0.002	0.000	0.001
88-03-31	14	19.028	18.131	-0.028	-0.044	-0.008	-0.013	-0.010
88-04-14	28	19.074	18.195	0.018	0.02	0.005	0.006	0.005
88-05-12	56	19.128	18.255	0.072	0.08	0.021	0.023	0.022
88-06-09	84	19.148	18.255	0.092	0.08	0.027	0.023	0.025
88-07-07	112	19.175	18.292	0.119	0.117	0.034	0.034	0.034
88-09-01	168	19.292	18.426	0.236	0.251	0.068	0.073	0.070
88-11-02	229	19.433	18.568	0.377	0.393	0.109	0.111	0.110
88-12-28	285	19.492	18.601	0.436	0.426	0.126	0.123	0.124
89-03-17	365	19.567	18.6	0.511	0.425	0.147	0.123	0.135
89-03-23	371	19.575	18.61	0.519	0.435	0.150	0.126	0.138
89-06-13	453	19.623	18.632	0.567	0.457	0.164	0.132	0.148
89-09-01	533	19.642	18.651	0.586	0.476	0.169	0.138	0.153

ACCELERATED CONCRETE PRISM TEST

Steed & Evans Quarry



ACCELERATED CONCRETE PRISM EXPANSION TEST DATA

TYPE AND SOURCE OF AGGREGATES : Steed & Evans Quarry

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-03-16

STARTING DATE OF TEST : 88-03-17

BATCH QUANTITIES:

CEMENT (kg) — - 13.95
FLY ASH (kg) - - 0
WATER (kg) — - 8.44
STONE (kg) — - 47.43
SAND (kg) — - 38.40

PROPERTIES OF MIX:

SLUMP (mm) — 70
AIR % — 1.6
28 DAY COMPRESSIVE STRENGTH (MPa) — 27.4
WATER : CEMENT RATIO — 0.51

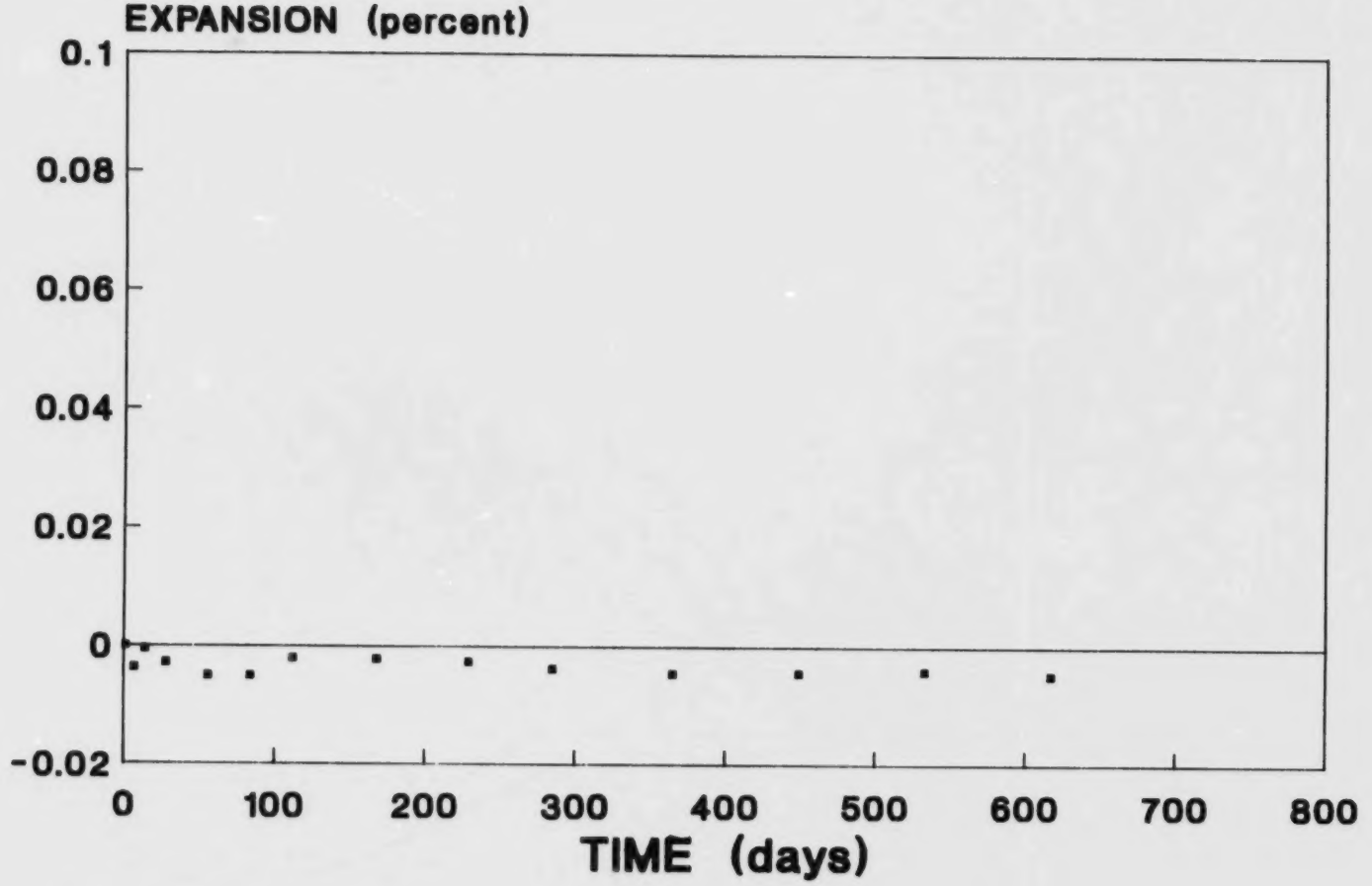
NaOH ADDED TO MIX WATER — — 64.8 g

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	347.074	348.929	349.077

DATE (d/m/y)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION PERCENT
88-03-17	1	19.473	19.328	21.416	0	0	0	0.000	0.000	0.000	0.000
88-03-24	7	19.484	19.331	21.41	0.011	0.003	-0.006	0.003	0.001	-0.002	0.001
88-03-30	14	19.48	19.315	21.41	0.007	-0.013	-0.006	0.002	-0.004	-0.002	-0.001
88-04-13	28	19.522	19.33	21.416	0.049	0.002	0	0.014	0.001	0.000	0.005
88-05-11	56	19.563	19.375	21.439	0.09	0.047	0.023	0.026	0.014	0.007	0.015
88-06-08	84	19.563	19.374	21.441	0.09	0.046	0.025	0.026	0.013	0.007	0.015
88-07-06	112	19.614	19.42	21.497	0.141	0.092	0.081	0.041	0.027	0.023	0.030
88-08-31	168	19.731	19.502	21.606	0.258	0.174	0.19	0.074	0.050	0.054	0.060
88-11-01	229	19.874	19.504	21.731	0.401	0.176	0.315	0.116	0.051	0.090	0.086
88-12-27	285	19.958	19.559	21.789	0.485	0.231	0.373	0.140	0.067	0.107	0.104
89-03-16	365	20.019	19.579	21.853	0.545	0.351	0.437	0.157	0.101	0.125	0.128
89-06-08	449	20.085	19.713	21.908	0.612	0.365	0.492	0.176	0.111	0.141	0.143
89-08-31	534	20.105	19.721	21.918	0.632	0.393	0.502	0.182	0.113	0.144	0.146
89-11-23	617	20.104	19.728	21.934	0.631	0.4	0.518	0.182	0.115	0.149	0.149

ACCELERATED CONCRETE PRISM TEST

Gateway Quarry



ACCELERATED CONCRETE PRISM EXPANSION TEST DATA

TYPE AND SOURCE OF AGGREGATES : Gateway Quarry

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-03-30

STARTING DATE OF TEST : 88-03-31

BATCH QUANTITIES:

CEMENT (kg) — - 13.95
FLY ASH (kg) - - 0
WATER (kg) — - 8.34
STONE (kg) — - 47.43
SAND (kg) — - 37.20

PROPERTIES OF MIX:

SLUMP (mm) —— 90
AIR % —— 1.8
28 DAY COMPRESSIVE STRENGTH (MPa) — 31.1
WATER : CEMENT RATIO — 0.80

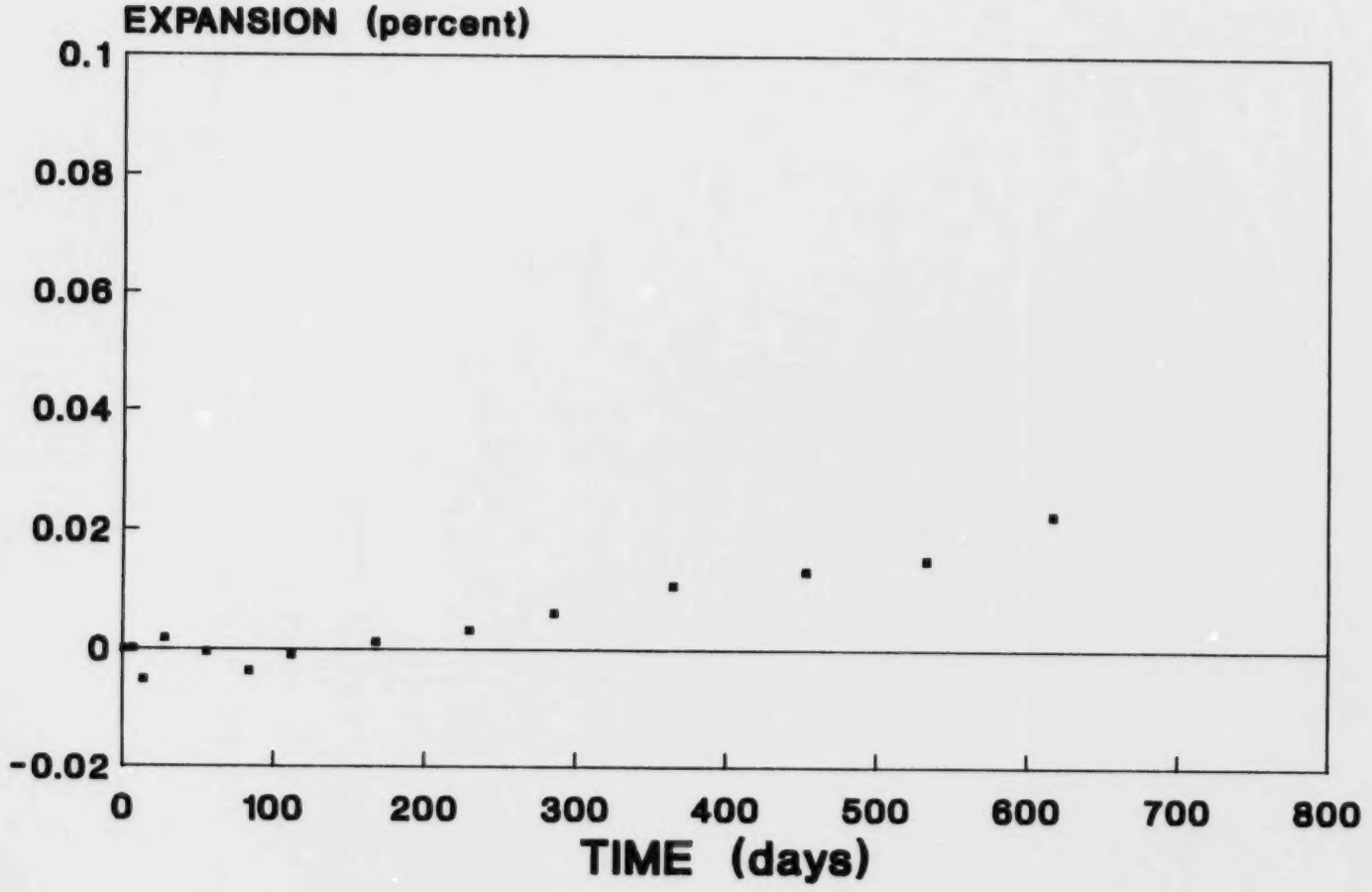
NaOH ADDED TO MIX WATER — — 64.8 g

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	344.535	345.932	346.157

DATE (d/m/y)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION PERCENT
88-03-31	1	16.934	16.331	16.556	0	0	0	0.000	0.000	0.000	0.000
88-04-05	7	16.928	16.306	16.549	-0.006	-0.025	-0.007	-0.002	-0.007	-0.002	-0.004
88-04-13	14	16.94	16.318	16.558	0.006	-0.013	0.002	0.002	-0.004	0.001	0.000
88-04-27	28	16.926	16.314	16.552	-0.008	-0.017	-0.004	-0.002	-0.005	-0.001	-0.003
88-05-25	56	16.946	16.311	16.512	0.012	-0.02	-0.044	0.003	-0.006	-0.013	-0.005
88-06-22	84	16.943	16.309	16.517	0.009	-0.022	-0.039	0.003	-0.006	-0.011	-0.005
88-07-20	112	16.961	16.319	16.52	0.027	-0.012	-0.036	0.008	-0.003	-0.010	-0.002
88-09-14	168	16.955	16.325	16.519	0.021	-0.006	-0.037	0.006	-0.002	-0.011	-0.002
88-11-15	229	16.955	16.319	16.52	0.021	-0.012	-0.036	0.006	-0.003	-0.010	-0.003
89-01-10	295	16.955	16.308	16.519	0.021	-0.023	-0.037	0.006	-0.007	-0.011	-0.004
89-03-30	365	16.95	16.308	16.516	0.016	-0.023	-0.04	0.005	-0.007	-0.012	-0.005
89-05-22	449	16.953	16.305	16.517	0.019	-0.026	-0.039	0.006	-0.008	-0.011	-0.004
89-09-14	533	16.952	16.304	16.523	0.018	-0.027	-0.033	0.005	-0.008	-0.010	-0.004
89-12-07	617	16.949	16.302	16.521	0.015	-0.029	-0.035	0.004	-0.008	-0.010	-0.005

ACCELERATED CONCRETE PRISM TEST

South Shore Sand & Gravel



ACCELERATED CONCRETE PRISM EXPANSION TEST DATA

TYPE AND SOURCE OF AGGREGATES : South Shore Sand & Gravel

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-03-17

STARTING DATE OF TEST : 88-03-18

BATCH QUANTITIES:

CEMENT (kg) — - 13.95
FLY ASH (kg) - - 0
WATER (kg) — - 8.54
STONE (kg) — - 47.43
SAND (kg) — - 38.04

PROPERTIES OF MIX:

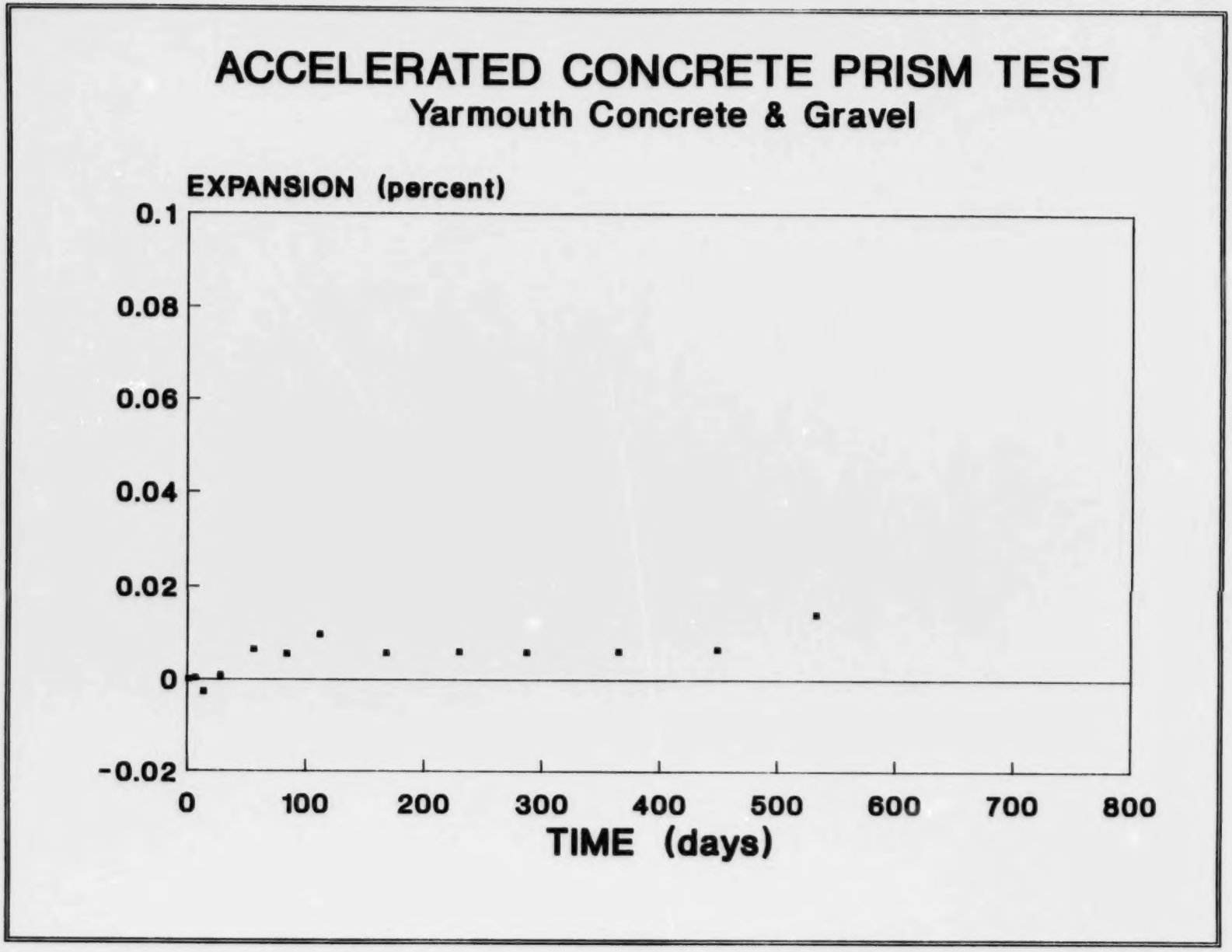
SLUMP (mm) — 80
AIR % — 1.6
28 DAY COMPRESSIVE STRENGTH (MPa) — 29.0
WATER : CEMENT RATIO — 0.61

NaOH ADDED TO MIX WATER — — 64.8 g

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	351.533	346.708	347.16

DATE (d/m/y)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION PERCENT
88-03-18	1	23.932	19.107		0	0		0.000	0.000		0.000
88-03-24	7	23.925	19.115		-0.007	0.008		-0.002	0.002		0.000
88-03-31	14	23.892	19.093		-0.04	-0.014		-0.011	-0.004		-0.005
88-04-14	28	23.933	19.125		0.001	0.018		0.000	0.005		0.002
88-05-12	56	23.923	19.111		-0.009	0.004		-0.003	0.001		0.000
88-06-09	84	23.906	19.094		-0.026	-0.013		-0.007	-0.004		-0.004
88-07-07	112	23.927	19.102		-0.005	-0.005		-0.001	-0.001		-0.001
88-09-01	168	23.936	19.116		0.004	0.009		0.001	0.003		0.001
88-11-02	230	23.949	19.124		0.017	0.017		0.005	0.005		0.003
88-12-28	286	23.961	19.142		0.029	0.035		0.008	0.010		0.006
89-03-17	365	23.990	19.153		0.057	0.046		0.019	0.013		0.011
89-06-13	453	24.014	19.163		0.082	0.056		0.023	0.016		0.013
89-09-01	533	24.024	19.173		0.092	0.066		0.026	0.019		0.015
89-11-24	617	24.07	19.205		0.138	0.098		0.039	0.028		0.023

NOTE: PRISM #3 REMOVED


ACCELERATED CONCRETE PRISM TEST
Yarmouth Concrete & Gravel
EXPANSION (percent)
0.1
0.08
0.06
0.04
0.02
0
-0.02
0
100
200
300
400
500
600
700
800
TIME (days)

ACCELERATED CONCRETE PRISM EXPANSION TEST DATA

TYPE AND SOURCE OF AGGREGATES : Yarmouth Concrete and Gravel

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-03-23

STARTING DATE OF TEST : 88-03-24

BATCH QUANTITIES:

CEMENT (kg) — - 12.71
FLY ASH (kg) - - 0
WATER (kg) — - 7.48
STONE (kg) — - 43.21
SAND (kg) — - 33.21

PROPERTIES OF MIX:

SLUMP (mm) — 85
AIR % — 1.8
28 DAY COMPRESSIVE STRENGTH (MPa) — 27.9
WATER : CEMENT RATIO — 0.59

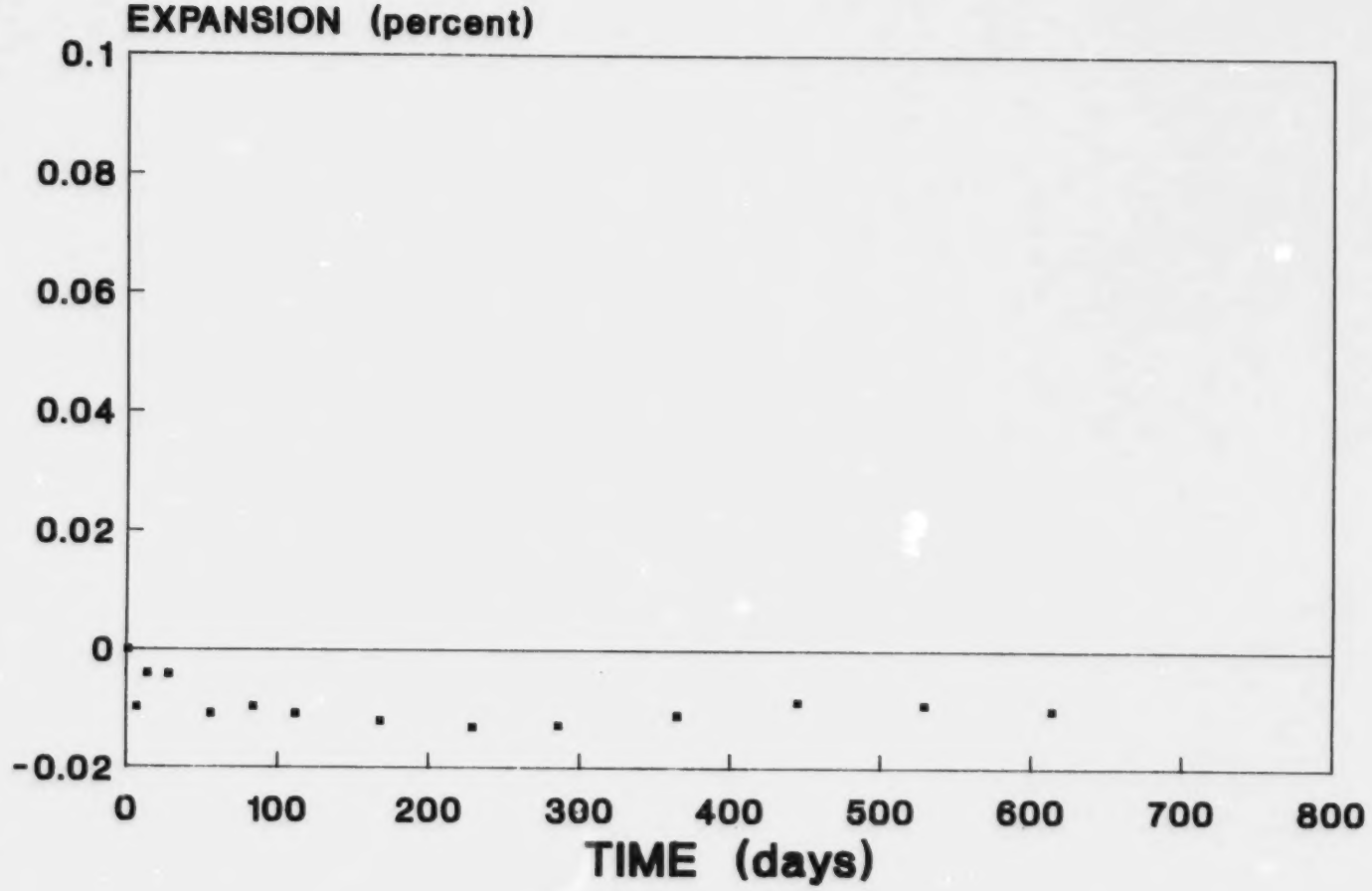
NaOH ADDED TO MIX WATER — — 59.0 g

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	346.422	349.244	345.245

DATE (d/m/y)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION PERCENT
88-03-24	1	18.821	21.643	17.644	0	0	0	0.000	0.000	0.000	0.000
88-03-30	7	18.806	21.647	17.658	-0.015	0.004	0.014	-0.004	0.001	0.004	0.000
88-04-06	14	18.8	21.636	17.644	-0.021	-0.007	0	-0.006	-0.002	0.000	-0.003
88-04-20	28	18.81	21.66	17.648	-0.011	0.017	0.004	-0.003	0.005	0.001	0.001
88-05-18	56	18.852	21.665	17.659	0.031	0.022	0.015	0.009	0.006	0.004	0.007
88-06-15	84	18.835	21.672	17.659	0.014	0.029	0.015	0.004	0.008	0.004	0.006
88-07-13	112	18.841	21.672	17.697	0.02	0.029	0.053	0.006	0.008	0.015	0.010
88-09-07	168	18.83	21.666	17.672	0.009	0.023	0.028	0.003	0.007	0.008	0.006
88-11-09	230	18.831	21.667	17.673	0.01	0.024	0.029	0.003	0.007	0.008	0.006
89-01-05	287	18.84	21.66	17.67	0.019	0.017	0.026	0.005	0.005	0.008	0.006
89-03-23	365	18.85	21.656	17.666	0.029	0.013	0.022	0.008	0.004	0.006	0.006
89-05-15	449	18.858	21.658	17.661	0.037	0.015	0.017	0.011	0.004	0.005	0.007
89-09-07	533	18.868	21.68	17.707	0.047	0.037	0.063	0.014	0.011	0.018	0.014

ACCELERATED CONCRETE PRISM TEST

V. J. Rice Pit



ACCELERATED CONCRETE PRISM EXPANSION TEST DATA

TYPE AND SOURCE OF AGGREGATES : V. J. Rice Ltd.

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-03-24

STARTING DATE OF TEST : 88-03-25

BATCH QUANTITIES:

CEMENT (kg) — - 8.68
FLY ASH (kg) - - 0
WATER (kg) — - 5.01
STONE (kg) — - 29.5
SAND (kg) — - 22.9

PROPERTIES OF MIX:

SLUMP (mm) — 80
AIR % — 1.8
28 DAY COMPRESSIVE STRENGTH (MPa) — 32.0
WATER : CEMENT RATIO — 0.58

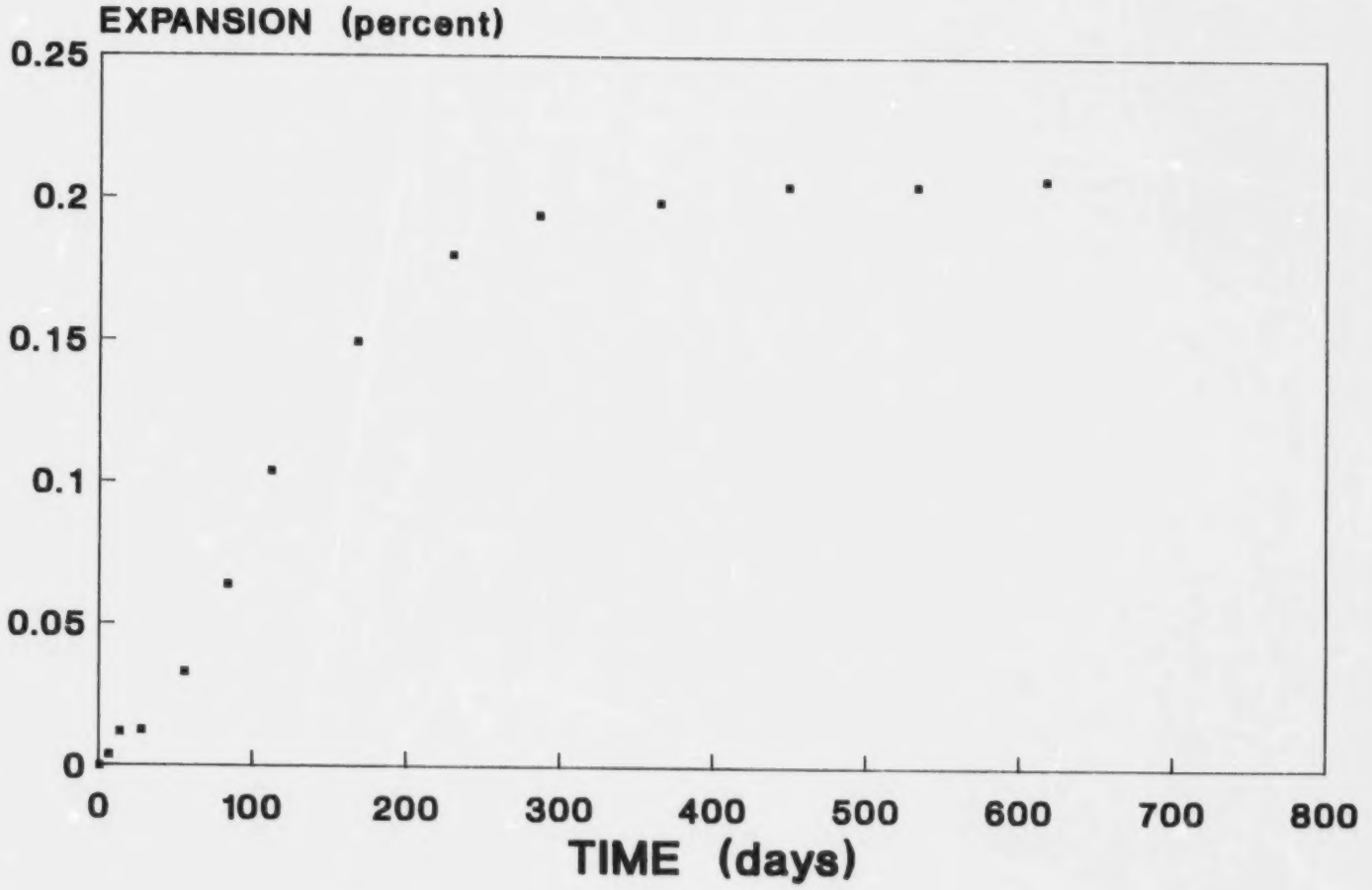
NaOH ADDED TO MIX WATER — — 40.3 g

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	345.594	344.069	345.739

DATE (d/m/y)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION PERCENT
88-03-24	1	17.993	16.468	18.138	0	0	0	0.000	0.000	0.000	0.000
88-03-31	7	17.951	16.439	18.098	-0.032	-0.029	-0.04	-0.009	-0.008	-0.012	-0.010
88-04-07	14	17.979	16.458	18.12	-0.014	-0.01	-0.018	-0.004	-0.003	-0.005	-0.004
88-04-21	28	17.977	16.46	18.119	-0.016	-0.009	-0.019	-0.005	-0.002	-0.005	-0.004
88-05-19	56	17.933	16.444	18.11	-0.05	-0.024	-0.028	-0.017	-0.007	-0.008	-0.011
88-06-16	84	17.938	16.452	18.109	-0.055	-0.016	-0.029	-0.016	-0.005	-0.008	-0.010
88-07-14	112	17.932	16.453	18.102	-0.061	-0.015	-0.036	-0.018	-0.004	-0.010	-0.011
88-09-08	168	17.911	16.473	18.091	-0.082	0.005	-0.047	-0.024	0.001	-0.014	-0.012
88-11-09	229	17.918	16.446	18.1	-0.075	-0.022	-0.038	-0.022	-0.006	-0.011	-0.013
89-01-04	286	17.925	16.446	18.095	-0.067	-0.022	-0.043	-0.019	-0.006	-0.012	-0.013
89-03-28	365	17.932	16.454	18.099	-0.061	-0.014	-0.039	-0.018	-0.004	-0.011	-0.011
89-06-16	445	17.939	16.464	18.106	-0.054	-0.004	-0.032	-0.016	-0.001	-0.009	-0.009
89-09-08	529	17.941	16.459	18.104	-0.052	-0.009	-0.034	-0.015	-0.003	-0.010	-0.009
89-12-01	614	17.934	16.455	18.106	-0.059	-0.013	-0.032	-0.017	-0.004	-0.009	-0.010

ACCELERATED CONCRETE PRISM TEST

Spratt Reference Aggregate



ACCELERATED CONCRETE PRISM EXPANSION TEST DATA

TYPE AND SOURCE OF AGGREGATES : Spratt Reference Aggregate

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-03-29

STARTING DATE OF TEST : 88-03-30

BATCH QUANTITIES:

CEMENT (kg) — - 13.95
FLY ASH (kg) - - 0
WATER (kg) — - 8.34
STONE (kg) — - 47.43
SAND (kg) — - 38.56

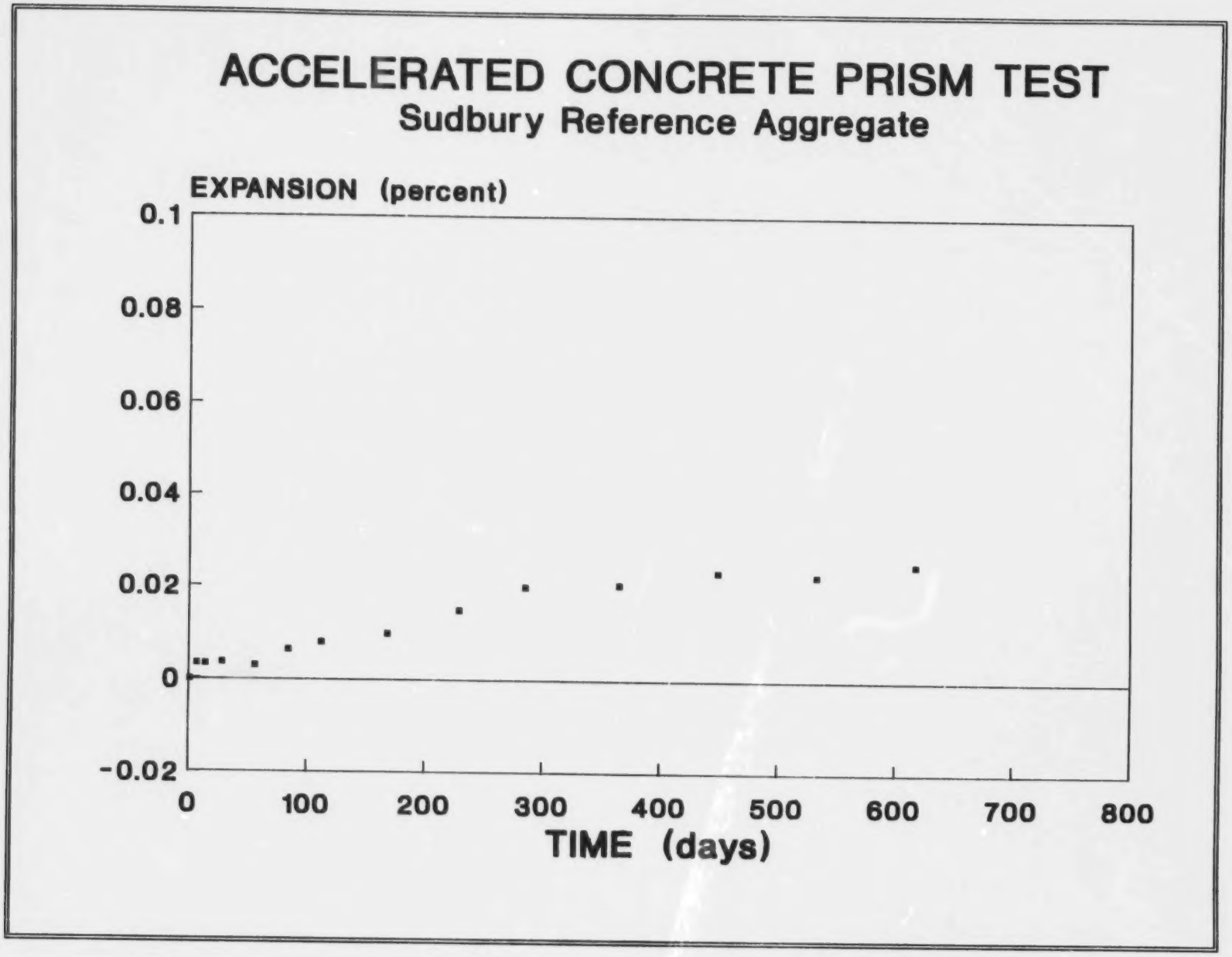
PROPERTIES OF MIX:

SLUMP (mm) — 85
AIR % — 1.8
28 DAY COMPRESSIVE STRENGTH (MPa) — 30.8
WATER : CEMENT RATIO — 0.60

NaOH ADDED TO MIX WATER — — 64.8 g

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	344.203	344.051	345.631

DATE (d/m/y)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION PERCENT
88-03-30	1	16.802	16.45	18.03	0	0	0	0.000	0.000	0.000	0.000
88-04-05	7	16.611	16.464	18.047	0.009	0.014	0.017	0.003	0.004	0.005	0.004
88-04-12	14	16.646	16.487	18.073	0.044	0.037	0.043	0.013	0.011	0.012	0.012
88-04-26	28	16.646	16.491	18.076	0.044	0.041	0.046	0.013	0.012	0.013	0.013
88-05-25	56	16.714	16.572	18.137	0.112	0.122	0.107	0.033	0.035	0.031	0.033
88-06-21	84	16.811	16.686	18.245	0.209	0.236	0.215	0.061	0.069	0.062	0.064
88-07-19	112	16.969	16.814	18.372	0.367	0.364	0.342	0.107	0.105	0.099	0.104
88-09-14	168	17.05	17.04	18.537	0.448	0.59	0.507	0.130	0.171	0.147	0.149
88-11-15	230	17.123	17.12	18.701	0.521	0.67	0.671	0.151	0.195	0.194	0.180
89-01-10	286	17.225	17.134	18.729	0.623	0.684	0.699	0.181	0.199	0.202	0.194
89-03-29	365	17.263	17.14	18.734	0.661	0.69	0.704	0.192	0.201	0.204	0.199
89-06-21	449	17.276	17.163	18.757	0.674	0.713	0.727	0.196	0.207	0.210	0.204
89-09-13	533	17.279	17.162	18.758	0.677	0.712	0.728	0.197	0.207	0.211	0.205
89-12-06	617	17.285	17.174	18.763	0.683	0.724	0.733	0.198	0.210	0.212	0.207


ACCELERATED CONCRETE PRISM TEST
Sudbury Reference Aggregate
EXPANSION (percent)
0.1
0.08
0.06
0.04
0.02
0
-0.02
0
100
200
300
400
500
600
700
800
TIME (days)

ACCELERATED CONCRETE PRISM EXPANSION TEST DATA

TYPE AND SOURCE OF AGGREGATES : Sudbury Reference Aggregate

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-03-30

STARTING DATE OF TEST : 88-03-31

BATCH QUANTITIES:

CEMENT (kg) — - 13.95
FLY ASH (kg) - - 0
WATER (kg) — - 8.34
STONE (kg) — - 47.43
SAND (kg) — - 38.21

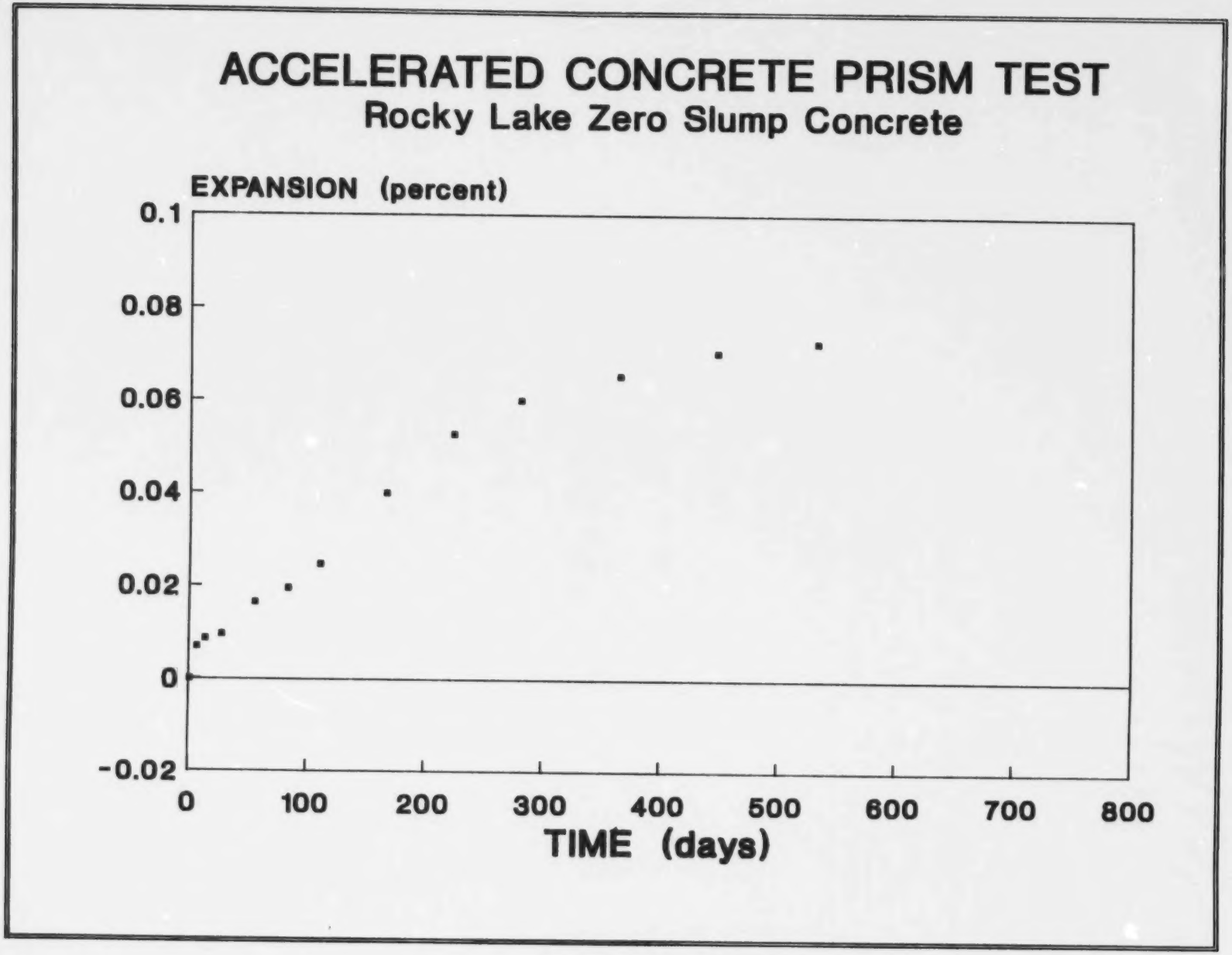
PROPERTIES OF MIX:

SLUMP (mm) — 85
AIR % — 2.3
28 DAY COMPRESSIVE STRENGTH (MPa) — 28.4
WATER : CEMENT RATIO — 0.60

NaOH ADDED TO MIX WATER — — 64.8 g

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	346.186	344.497	346.853

DATE (d/m/y)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION PERCENT
88-03-31	1	10.406	8.717	10.073	0	0	0	0.000	0.000	0.000	0.000
88-04-05	7	10.419	8.736	10.076	0.013	0.019	0.003	0.004	0.006	0.001	0.003
88-04-13	14	10.429	8.725	10.076	0.023	0.008	0.003	0.007	0.002	0.001	0.003
88-04-27	28	10.424	8.733	10.077	0.018	0.016	0.004	0.005	0.005	0.001	0.004
88-05-25	56	10.427	8.729	10.07	0.021	0.012	-0.003	0.006	0.003	-0.001	0.003
88-06-22	84	10.434	8.744	10.064	0.028	0.027	0.011	0.008	0.008	0.003	0.006
88-07-20	112	10.444	8.745	10.09	0.038	0.028	0.017	0.011	0.008	0.005	0.008
88-09-14	168	10.444	8.755	10.099	0.038	0.038	0.026	0.011	0.011	0.008	0.010
88-11-15	229	10.451	8.766	10.123	0.055	0.049	0.05	0.016	0.014	0.014	0.015
89-01-10	285	10.467	8.788	10.127	0.081	0.071	0.054	0.023	0.021	0.016	0.020
89-03-30	365	10.502	8.76	10.126	0.096	0.063	0.053	0.028	0.018	0.015	0.020
89-06-22	449	10.518	8.785	10.134	0.112	0.088	0.061	0.032	0.020	0.018	0.023
89-09-14	533	10.521	8.78	10.128	0.115	0.083	0.055	0.033	0.016	0.016	0.022
89-12-07	617	10.537	8.783	10.135	0.131	0.086	0.062	0.038	0.019	0.018	0.025


ACCELERATED CONCRETE PRISM TEST
Rocky Lake Zero Slump Concrete
EXPANSION (percent)
0.1
0.08
0.06
0.04
0.02
0
-0.02
0
100
200
300
400
500
600
700
800
TIME (days)

ACCELERATED CONCRETE PRISM EXPANSION TEST DATA

TYPE AND SOURCE OF AGGREGATES : Rocky Lake Quarry, Zero Slump Concrete

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-06-01

STARTING DATE OF TEST : 88-06-02

BATCH QUANTITIES:

CEMENT (kg) — - 13.95
FLY ASH (kg) - - 0
WATER (kg) — - 6.19
STONE (kg) — - 47.43
SAND (kg) — - 38.57

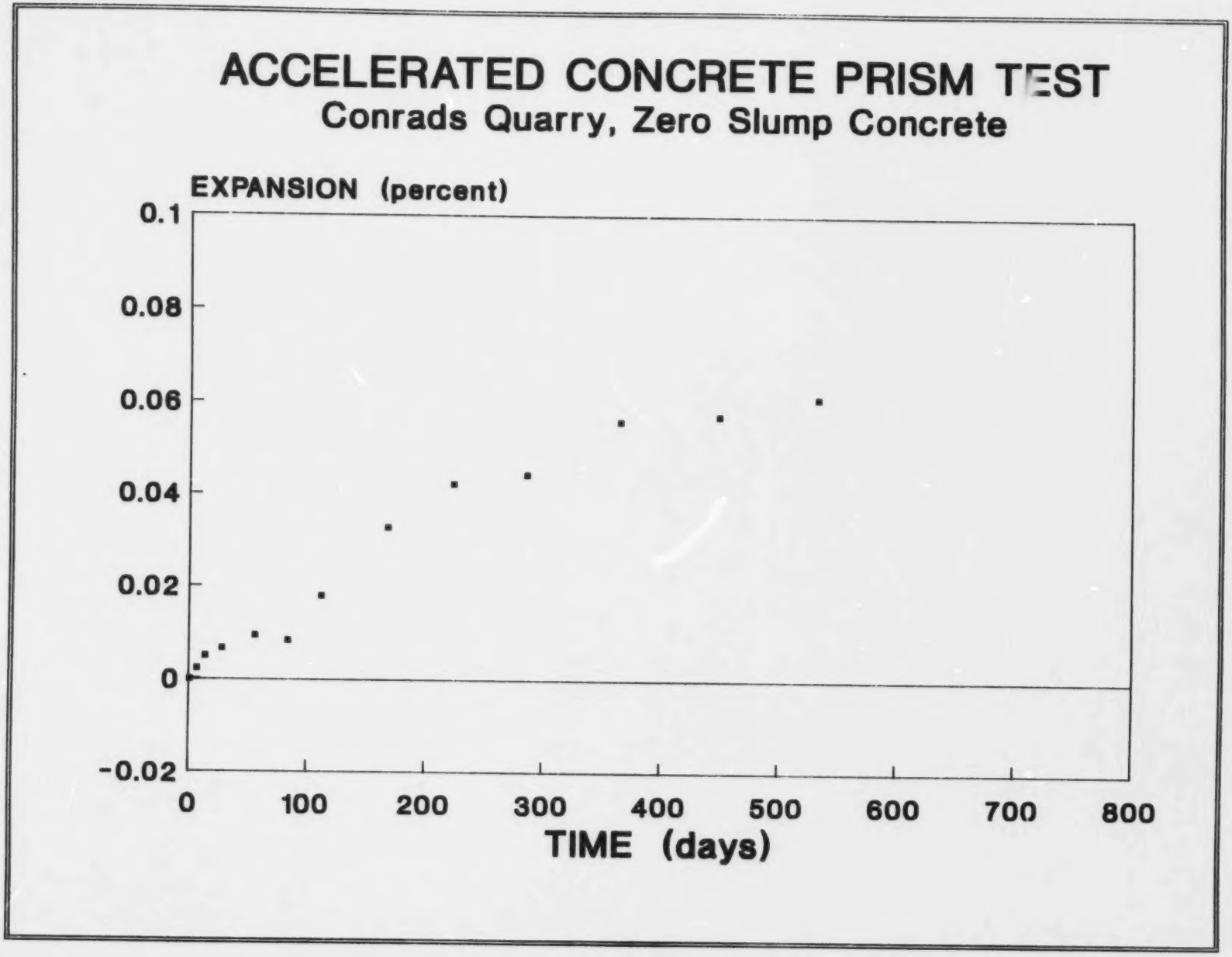
PROPERTIES OF MIX:

SLUMP (mm) — 0
AIR % — 3.0
28 DAY COMPRESSIVE STRENGTH (MPa) — 37.9
WATER : CEMENT RATIO — 0.44

NaOH ADDED TO MIX WATER — — 64.8 g

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	345.813	344.83	345.732

DATE (d/m/y)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION PERCENT
88-06-02	1	10.033	8.85	9.952	0	0	0	0.000	0.000	0.000	0.000
88-06-08	7	10.048	8.875	9.984	0.015	0.025	0.032	0.004	0.007	0.009	0.007
88-06-15	14	10.051	8.879	9.995	0.018	0.029	0.043	0.005	0.008	0.012	0.009
88-06-29	28	10.052	8.883	10	0.019	0.033	0.048	0.005	0.010	0.014	0.010
88-07-27	56	10.073	8.912	10.021	0.04	0.062	0.069	0.012	0.018	0.020	0.017
88-08-24	84	10.085	8.92	10.032	0.052	0.07	0.08	0.015	0.020	0.023	0.019
88-09-21	111	10.105	8.938	10.047	0.072	0.088	0.095	0.021	0.026	0.027	0.025
88-11-16	167	10.174	8.971	10.103	0.141	0.121	0.151	0.041	0.035	0.044	0.040
89-01-12	224	10.217	9.012	10.151	0.184	0.162	0.199	0.053	0.047	0.058	0.053
89-03-09	281	10.249	9.034	10.174	0.216	0.184	0.222	0.062	0.053	0.064	0.060
89-05-01	365	10.275	9.055	10.183	0.242	0.205	0.231	0.070	0.059	0.067	0.065
89-08-23	448	10.292	9.077	10.195	0.259	0.227	0.244	0.075	0.066	0.071	0.070
89-11-16	533	10.303	9.081	10.205	0.27	0.231	0.253	0.078	0.067	0.073	0.073


ACCELERATED CONCRETE PRISM TEST
Conrads Quarry, Zero Slump Concrete
EXPANSION (percent)
0.1
0.08
0.06
0.04
0.02
0
-0.02
0
100
200
300
400
500
600
700
800
TIME (days)

ACCELERATED CONCRETE PRISM EXPANSION TEST DATA

TYPE AND SOURCE OF AGGREGATES : Conrade Quarry, Zero Slump Concrete

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-06-14

STARTING DATE OF TEST : 88-06-15

BATCH QUANTITIES:

CEMENT (kg) — - 7.35
FLY ASH (kg) - - 0
WATER (kg) — - 3.87
STONE (kg) — - 25.0
SAND (kg) — - 19.92

PROPERTIES OF MIX:

SLUMP (mm) —— 0
AIR % —— 2.8
28 DAY COMPRESSIVE STRENGTH (MPa) — 25.2
WATER : CEMENT RATIO — 0.53

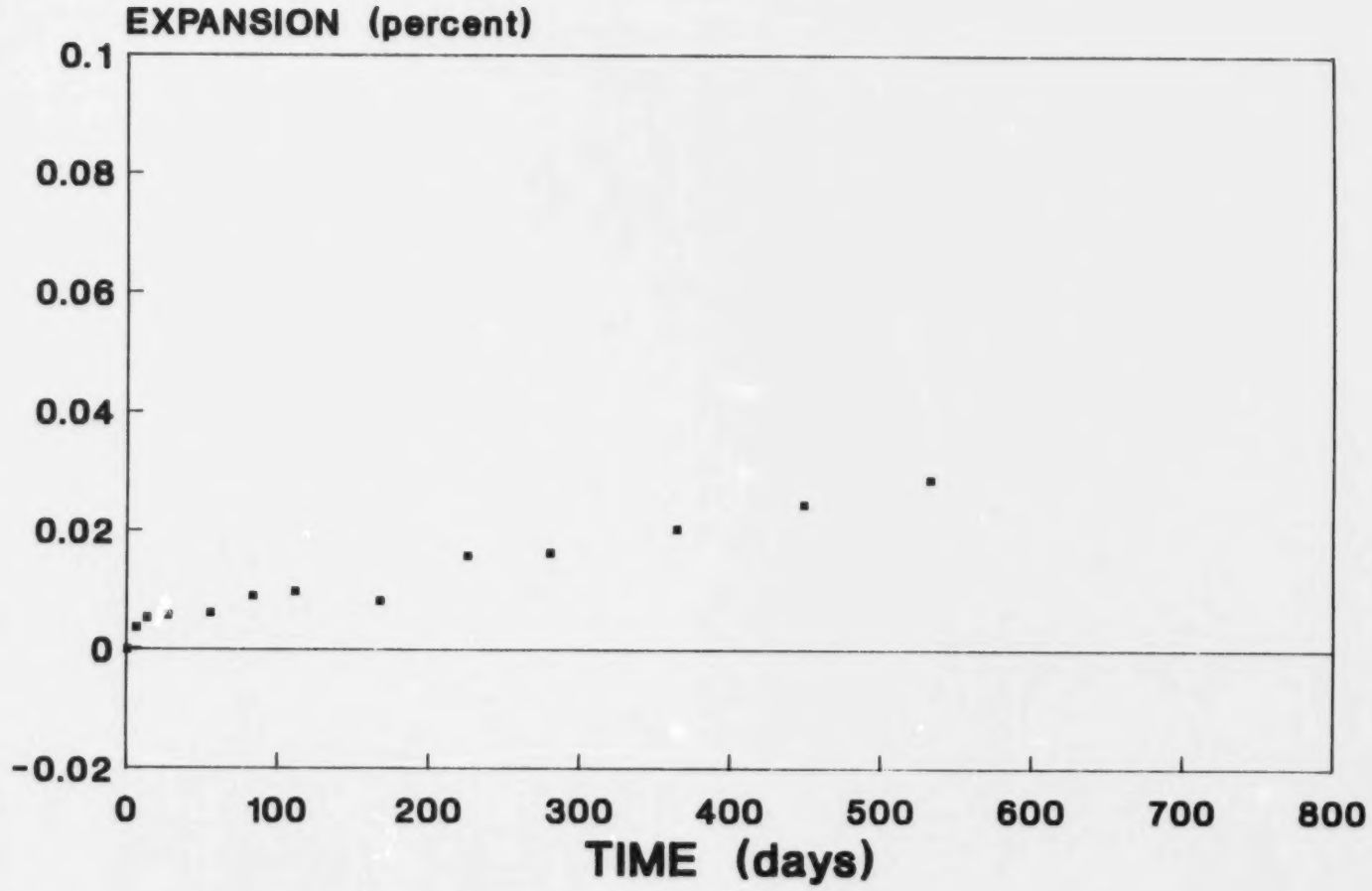
NaOH ADDED TO MIX WATER — — 64.8 g

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	344.464	344.854	345.926

DATE (d/m/y)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION PERCENT
88-06-15	1	8.884	9.074	10.146	0	0	0	0.000	0.000	0.000	0.000
88-06-22	7	8.893	9.084	10.151	0.009	0.01	0.005	0.003	0.003	0.001	0.002
88-06-29	14	8.702	9.092	10.162	0.018	0.018	0.016	0.005	0.005	0.005	0.005
88-07-13	28	8.719	9.098	10.156	0.035	0.024	0.01	0.010	0.007	0.003	0.007
88-08-10	56	8.719	9.114	10.189	0.035	0.04	0.023	0.010	0.012	0.007	0.009
88-09-07	84	8.717	9.108	10.168	0.033	0.032	0.022	0.010	0.009	0.006	0.008
88-10-05	112	8.748	9.144	10.198	0.064	0.07	0.052	0.019	0.020	0.015	0.018
88-11-30	168	8.806	9.204	10.232	0.122	0.13	0.086	0.035	0.038	0.025	0.033
89-01-25	224	8.854	9.241	10.245	0.17	0.167	0.099	0.049	0.048	0.029	0.042
89-03-28	266	8.861	9.254	10.246	0.177	0.18	0.1	0.051	0.052	0.029	0.044
89-06-15	365	8.904	9.301	10.277	0.22	0.227	0.131	0.064	0.066	0.038	0.056
89-09-07	448	8.911	9.305	10.279	0.227	0.231	0.133	0.066	0.067	0.038	0.057
89-11-30	533	8.931	9.321	10.283	0.247	0.247	0.137	0.072	0.072	0.040	0.061

ACCELERATED CONCRETE PRISM TEST

Gateway Quarry, Zero Slump Concrete



ACCELERATED CONCRETE PRISM EXPANSION TEST DATA

TYPE AND SOURCE OF AGGREGATES : Gateway Quarry, Zero Slump Concrete

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-05-31

STARTING DATE OF TEST : 88-06-01

BATCH QUANTITIES:

CEMENT (kg) — - 13.95
FLY ASH (kg) - - 0
WATER (kg) — - 6.54
STONE (kg) — - 47.43
SAND (kg) — - 37.80

PROPERTIES OF MIX:

SLUMP (mm) — 0
AIR % — 2.7
28 DAY COMPRESSIVE STRENGTH (MPa) — 34.2
WATER : CEMENT RATIO — 0.47

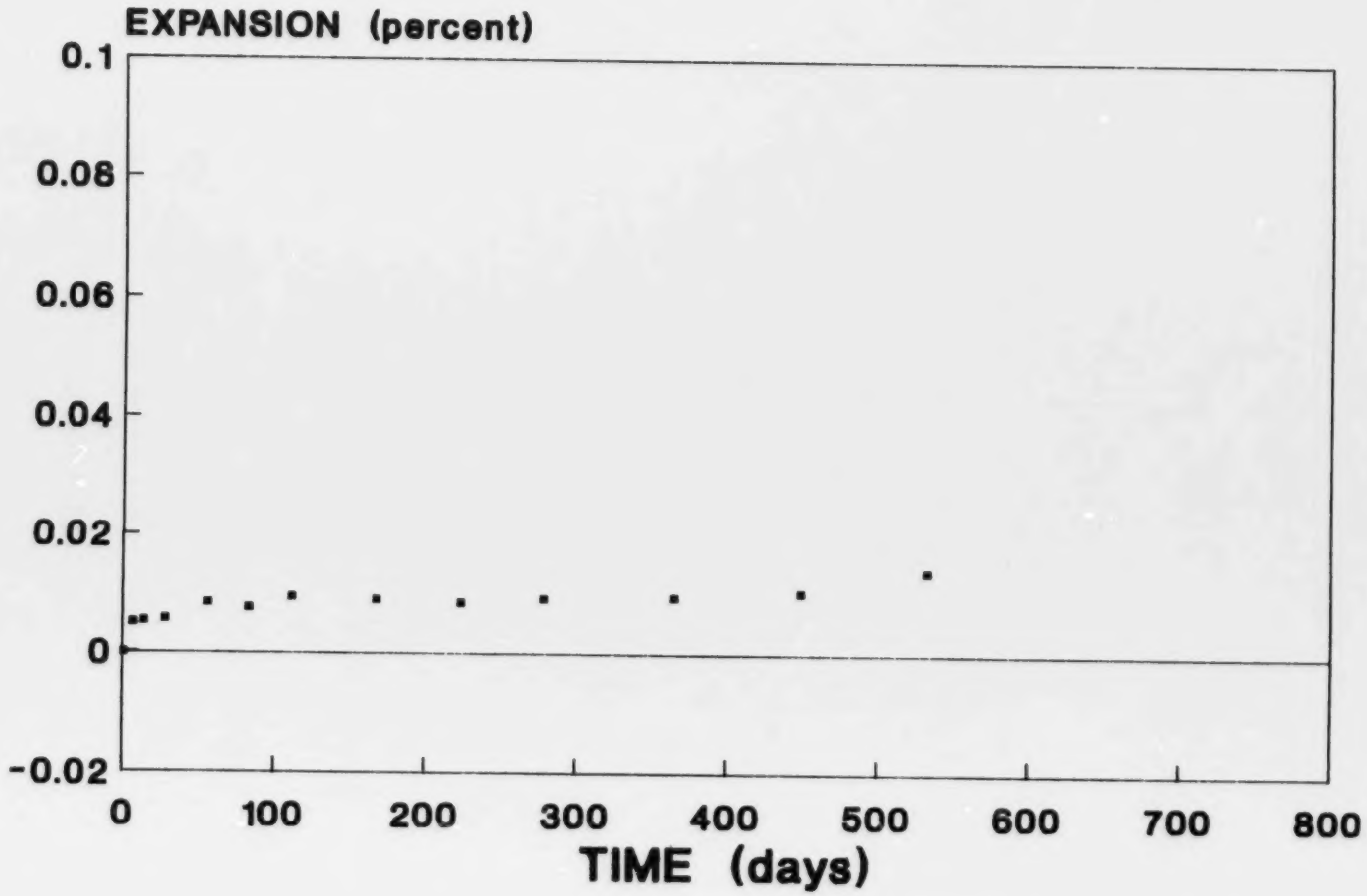
NaOH ADDED TO MIX WATER — — 64.8 g

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	351.704	346.185	344.323

DATE (d/m/y)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION PERCENT
88-06-01	1	15.924	10.405	8.543	0	0	0	0.000	0.000	0.000	0.000
88-06-07	7	15.933	10.443	8.534	0.009	0.038	-0.009	0.003	0.011	-0.003	0.004
88-06-14	14	15.943	10.434	8.55	0.019	0.029	0.007	0.005	0.008	0.002	0.005
88-06-28	28	15.952	10.432	8.548	0.028	0.027	0.005	0.008	0.008	0.001	0.005
88-07-26	56	15.957	10.428	8.551	0.033	0.023	0.008	0.009	0.007	0.002	0.006
88-08-23	84	15.968	10.436	8.562	0.044	0.031	0.019	0.013	0.009	0.006	0.009
88-09-21	112	15.972	10.438	8.564	0.048	0.033	0.021	0.014	0.010	0.006	0.010
88-11-15	168	15.982	10.433	8.562	0.038	0.028	0.019	0.011	0.008	0.006	0.008
89-01-12	226	15.991	10.452	8.594	0.057	0.047	0.051	0.019	0.014	0.015	0.016
89-03-08	281	15.996	10.452	8.594	0.072	0.047	0.051	0.020	0.014	0.015	0.016
89-05-31	365	16.02	10.455	8.609	0.096	0.05	0.066	0.027	0.014	0.019	0.020
89-08-23	449	16.038	10.465	8.624	0.114	0.06	0.081	0.032	0.017	0.024	0.024
89-11-16	533	16.057	10.486	8.628	0.133	0.081	0.085	0.038	0.023	0.025	0.029

ACCELERATED CONCRETE PRISM TEST

Yarmouth Concrete & Gravel, Zero Slump



ACCELERATED CONCRETE PRISM EXPANSION TEST DATA

TYPE AND SOURCE OF AGGREGATES : Yarmouth Concrete & Gravel, Zero Slump Concrete

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-05-25

STARTING DATE OF TEST : 88-05-26

BATCH QUANTITIES:

CEMENT (kg) — - 13.95
FLY ASH (kg) - - 0
WATER (kg) —— - 6.14
STONE (kg) —— - 47.43
SAND (kg) —— - 37.48

PROPERTIES OF MIX:

SLUMP (mm) —— 0
AIR % ———— 2.0
28 DAY COMPRESSIVE STRENGTH (MPa) — 36.5
WATER : CEMENT RATIO — 0.44

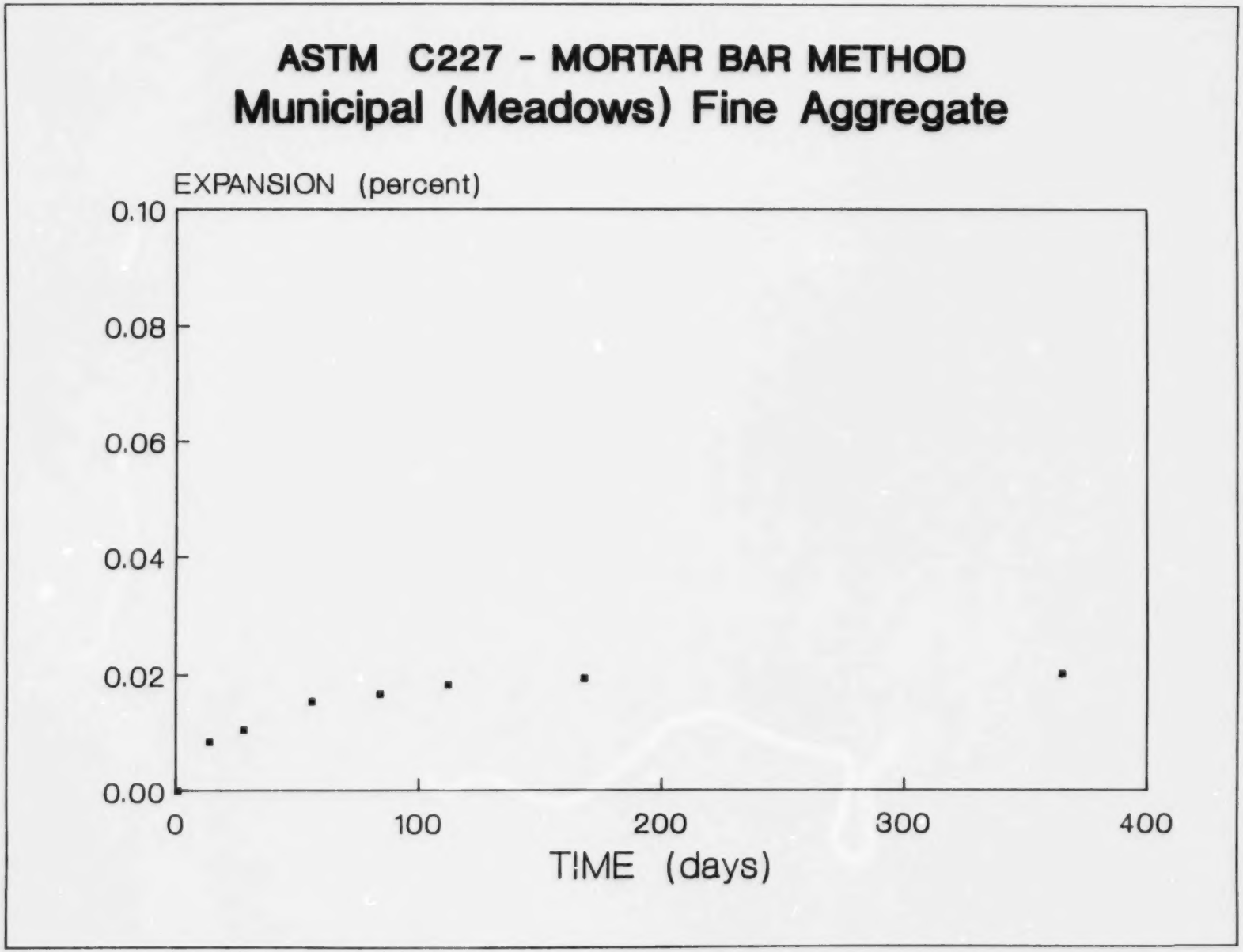
NaOH ADDED TO MIX WATER — — 64.8 g

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	345.411	345.47	346.395

DATE (d/m/y)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION PERCENT
88-05-26	1	9.631	9.69	10.615	0	0	0	0.000	0.000	0.000	0.000
88-06-02	7	9.656	9.7	10.633	0.025	0.01	0.018	0.007	0.003	0.005	0.005
88-06-08	14	9.659	9.703	10.63	0.028	0.013	0.015	0.008	0.004	0.004	0.005
88-06-22	28	9.658	9.705	10.632	0.027	0.015	0.017	0.008	0.004	0.005	0.006
88-07-20	56	9.655	9.716	10.643	0.034	0.026	0.028	0.010	0.008	0.008	0.008
88-08-17	84	9.651	9.717	10.637	0.03	0.027	0.022	0.009	0.008	0.006	0.008
88-09-14	112	9.656	9.721	10.646	0.037	0.031	0.031	0.011	0.009	0.009	0.010
88-11-09	168	9.655	9.721	10.644	0.034	0.031	0.029	0.010	0.009	0.008	0.009
89-01-05	224	9.655	9.717	10.643	0.034	0.027	0.028	0.010	0.008	0.008	0.009
89-03-01	279	9.656	9.719	10.648	0.035	0.029	0.033	0.010	0.008	0.010	0.009
89-05-25	365	9.671	9.721	10.644	0.04	0.031	0.029	0.012	0.009	0.008	0.010
89-08-17	449	9.675	9.722	10.648	0.044	0.032	0.033	0.013	0.009	0.010	0.011
89-11-09	533	9.687	9.745	10.65	0.056	0.055	0.035	0.016	0.016	0.010	0.014

APPENDIX

3


ASTM C227 - MORTAR BAR METHOD
Municipal (Meadows) Fine Aggregate
EXPANSION (percent)
0.10
0.08
0.06
0.04
0.02
0.00
0
100
200
300
400
TIME (days)

ASTM C227 - MORTAR BAR METHOD

TYPE AND SOURCE OF AGGREGATES : Municipal (Meadows), Sand

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-05-24

STARTING DATE OF TEST : 88-05-25

BATCH QUANTITIES:

CEMENT (g) — 300

FLY ASH (g) - 0

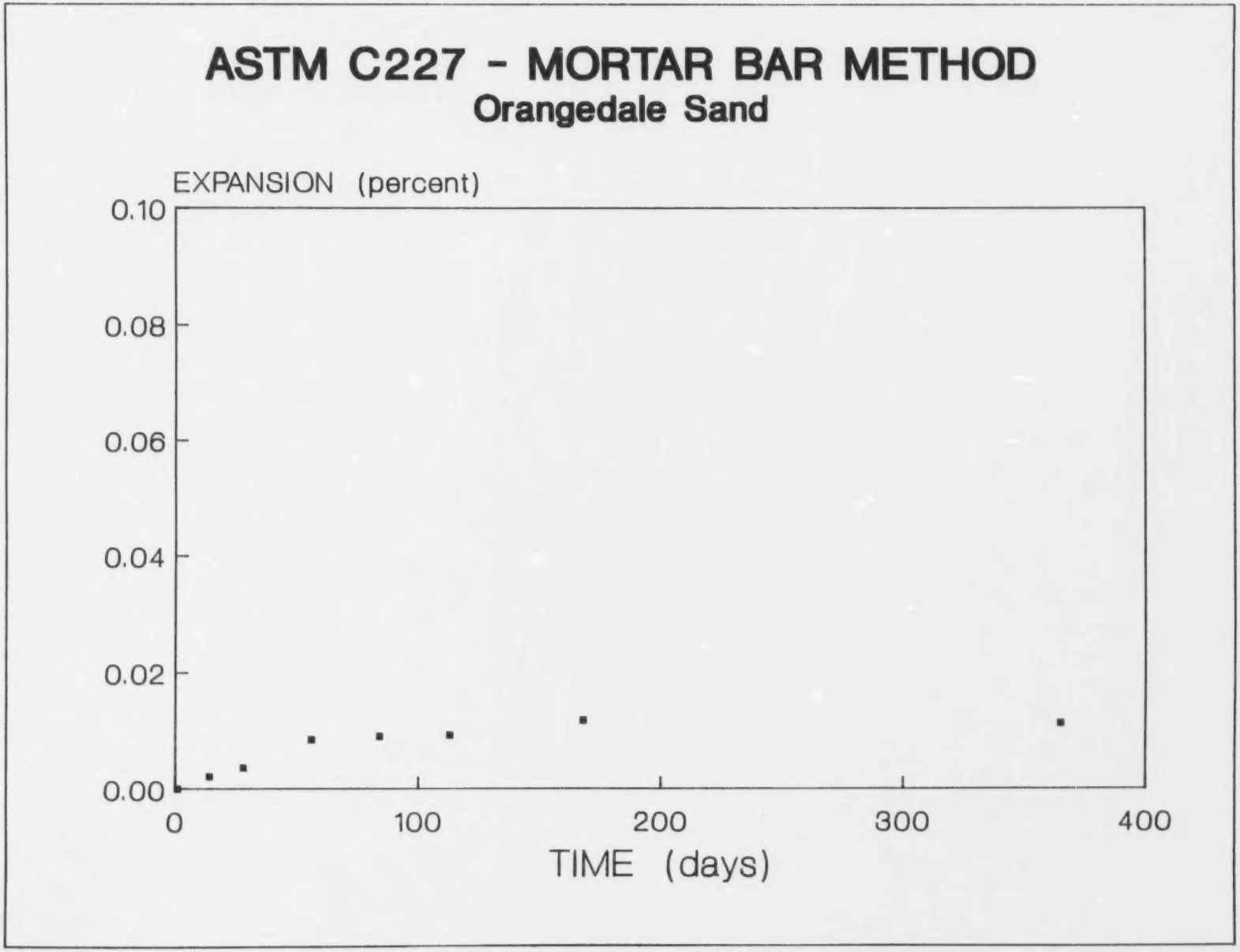
WATER (ml) — 158

SAND (g) —— 675

Flow ——— 108

	1	2	3	4
INITIAL SAMPLE LENGTH (mm) —	245.13	245.699	243.863	246.40

DATE (DD-MM-YY)	AGE (days)	GAUGE READING (mm) 1	2	3	4	LENGTH CHANGE (mm) 1	2	3	4	PERCENT EXPANSION 1	2	3	4	AVERAGE EXPANSION %
88-05-25	1	-10.475	-9.906	-11.74	-9.202	0	0	0	0	0.000	0.000	0.000	0.000	0.000
88-06-07	14	-10.453	-9.886	-11.72	-9.18	0.022	0.02	0.019	0.022	0.009	0.008	0.008	0.009	0.008
88-06-21	28	-10.452	-9.883	-11.71	-9.175	0.023	0.023	0.03	0.027	0.009	0.009	0.012	0.011	0.011
88-07-19	56	-10.441	-9.866	-11.70	-9.163	0.034	0.04	0.038	0.039	0.014	0.016	0.016	0.016	0.015
88-08-16	84	-10.436	-9.864	-11.70	-9.16	0.039	0.042	0.04	0.042	0.016	0.017	0.016	0.017	0.017
88-09-14	112	-10.429	-9.861	-11.69	-9.162	0.046	0.045	0.047	0.04	0.019	0.018	0.019	0.016	0.018
88-11-08	168	-10.426	-9.855	-11.69	-9.157	0.049	0.051	0.044	0.045	0.020	0.021	0.018	0.018	0.019
89-05-24	365	-10.43	-9.851	-11.69	-9.15	0.045	0.055	0.045	0.052	0.018	0.023	0.018	0.021	0.020


ASTM C227 - MORTAR BAR METHOD
Orangedale Sand
EXPANSION (percent)
0.10
0.08
0.06
0.04
0.02
0.00
0
100
200
300
400
TIME (days)

ASTM C227 - MORTAR BAR METHOD

TYPE AND SOURCE OF AGGREGATES : Orangedale Sand

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-05-24

STARTING DATE OF TEST : 88-05-25

BATCH QUANTITIES:

CEMENT (g) — 300

FLY ASH (g) - 0

WATER (ml) — 154

SAND (g) —— 675

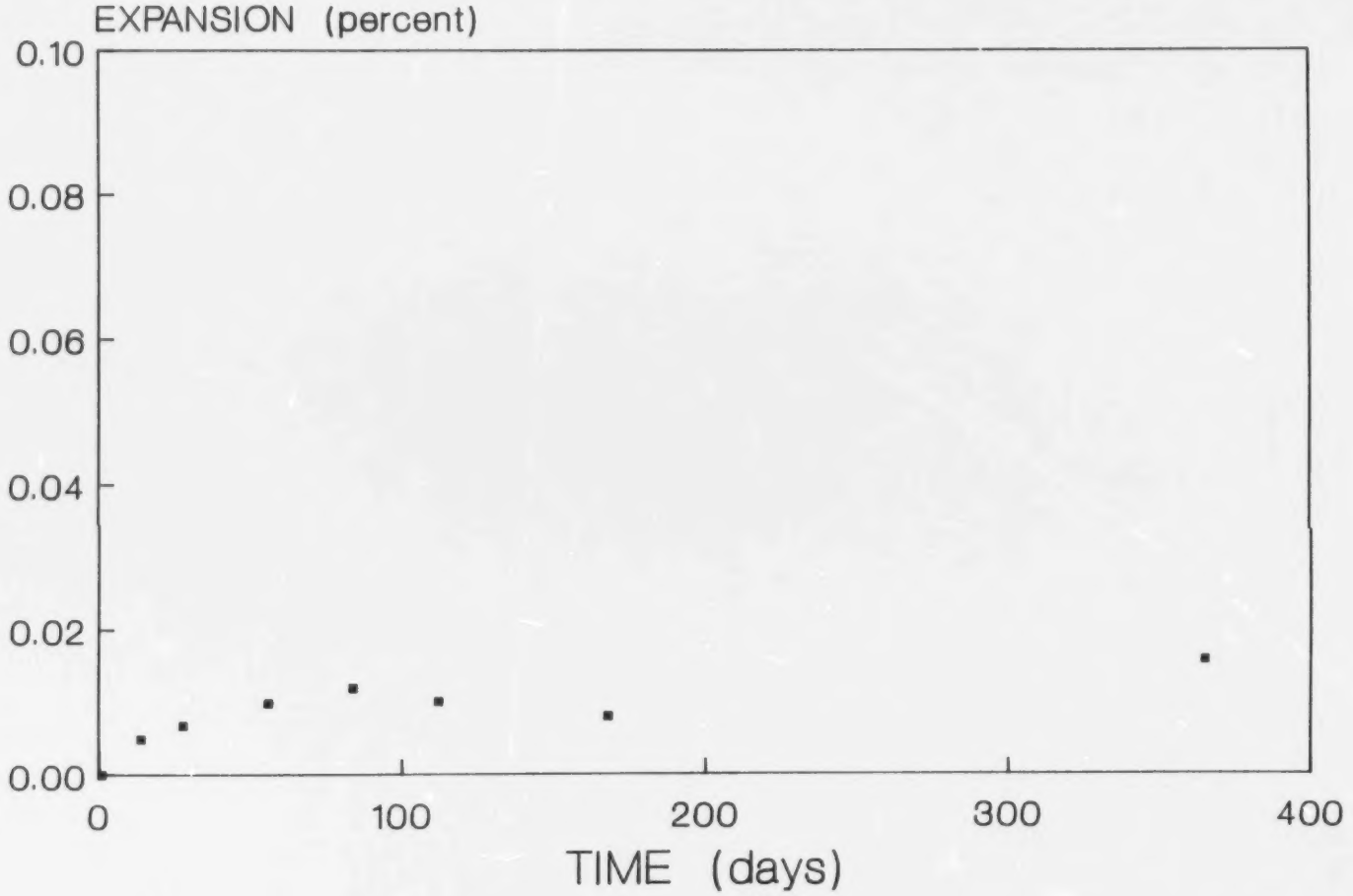
Flow ----- 114

	1	2	3	4
INITIAL SAMPLE LENGTH (mm) —	245.562	246.278	246.814	247.167

DATE	AGE	GAUGE READING (mm)				LENGTH CHANGE (mm)				PERCENT EXPANSION				AVERAGE EXPANSION
(DD-MM-YY)	(days)	1	2	3	4	1	2	3	4	1	2	3	4	%
88-05-25	1	-10.043	-9.327	-8.791	-8.438	0	0	0	0	0.000	0.000	0.000	0.000	0.000
88-06-07	14	-10.031	-9.32	-8.797	-8.43	0.012	0.007	-0.006	0.008	0.005	0.003	-0.002	0.003	0.002
88-06-21	28	-10.029	-9.317	-8.788	-8.429	0.014	0.01	0.003	0.009	0.006	0.004	0.001	0.004	0.004
88-07-19	56	-10.022	-9.305	-8.775	-8.413	0.021	0.022	0.016	0.025	0.009	0.009	0.006	0.010	0.009
88-08-16	84	-10.02	-9.303	-8.774	-8.412	0.023	0.024	0.017	0.026	0.009	0.010	0.007	0.011	0.009
88-09-14	113	-10.019	-9.303	-8.773	-8.412	0.024	0.024	0.018	0.026	0.010	0.010	0.007	0.011	0.009
88-11-08	168	-10.015	-9.295	-8.767	-8.405	0.028	0.032	0.024	0.033	0.011	0.013	0.010	0.013	0.012
89-05-24	365	-10.02	-9.293	-8.768	-8.406	0.023	0.034	0.023	0.032	0.009	0.014	0.009	0.013	0.011

ASTM C227, MORTAR BAR METHOD

Barneys River, Fine Aggregate



ASTM C227 - MORTAR BAR METHOD

TYPE AND SOURCE OF AGGREGATES : Barney's River

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-05-31

STARTING DATE OF TEST : 88-06-01

BATCH QUANTITIES:

CEMENT (g) — 300

FLY ASH (g) - 0

WATER (ml) — 186

SAND (g) — 575

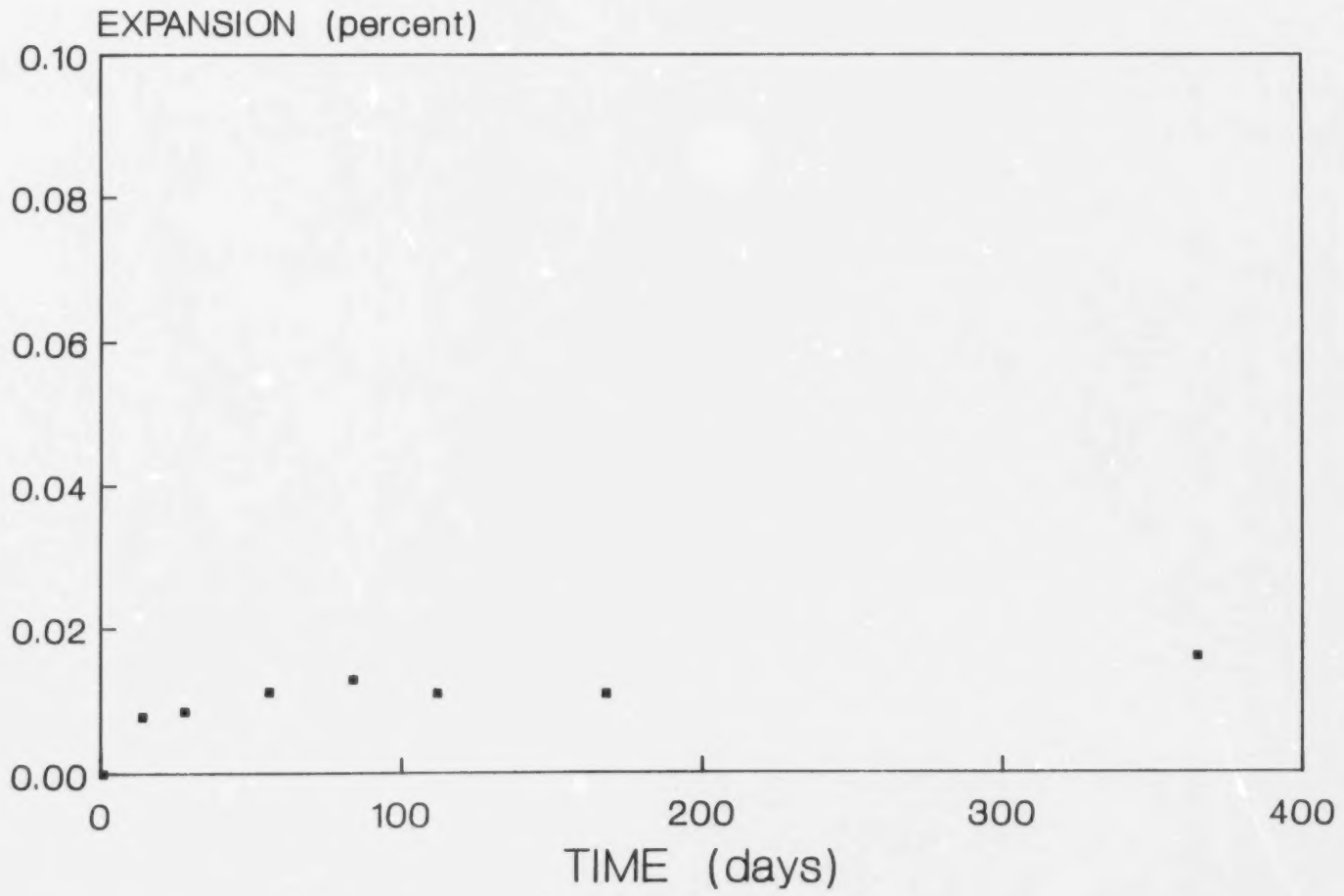
Flow —— 119

	1	2
INITIAL SAMPLE LENGTH (mm) —	244.057	242.519

DATE (DD-MM-YY)	AGE (days)	GAUGE READING (m) 1	2	LENGTH CHANGE (mm) 1	2	PERCENT EXPANSION 1	2	AVERAGE EXPANSION %
88-06-01	1	-11.538	-13.086	0	0	0.000	0.000	0.000
88-06-14	14	-11.524	-13.076	0.014	0.01	0.006	0.004	0.005
88-06-28	28	-11.521	-13.07	0.017	0.016	0.007	0.007	0.007
88-07-26	56	-11.515	-13.061	0.023	0.025	0.009	0.010	0.010
88-08-23	84	-11.506	-13.06	0.032	0.026	0.013	0.011	0.012
88-09-20	112	-11.513	-13.062	0.025	0.024	0.010	0.010	0.010
88-11-15	168	-11.52	-13.065	0.018	0.021	0.007	0.009	0.008
89-05-31	365	-11.502	-13.045	0.036	0.041	0.015	0.017	0.016

ASTM C227, MORTAR BAR METHOD

Nova Scotia Sand & Gravel, Shubenacadie



ASTM C227 - MORTAR BAR METHOD

TYPE AND SOURCE OF AGGREGATES : Nova Scotia Sand & Gravel, Shubenacadie

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-05-31

STARTING DATE OF TEST : 88-06-01

BATCH QUANTITIES:

CEMENT (g) — 300

FLY ASH (g) - 0

WATER (ml) — 158

SAND (g) —— 675

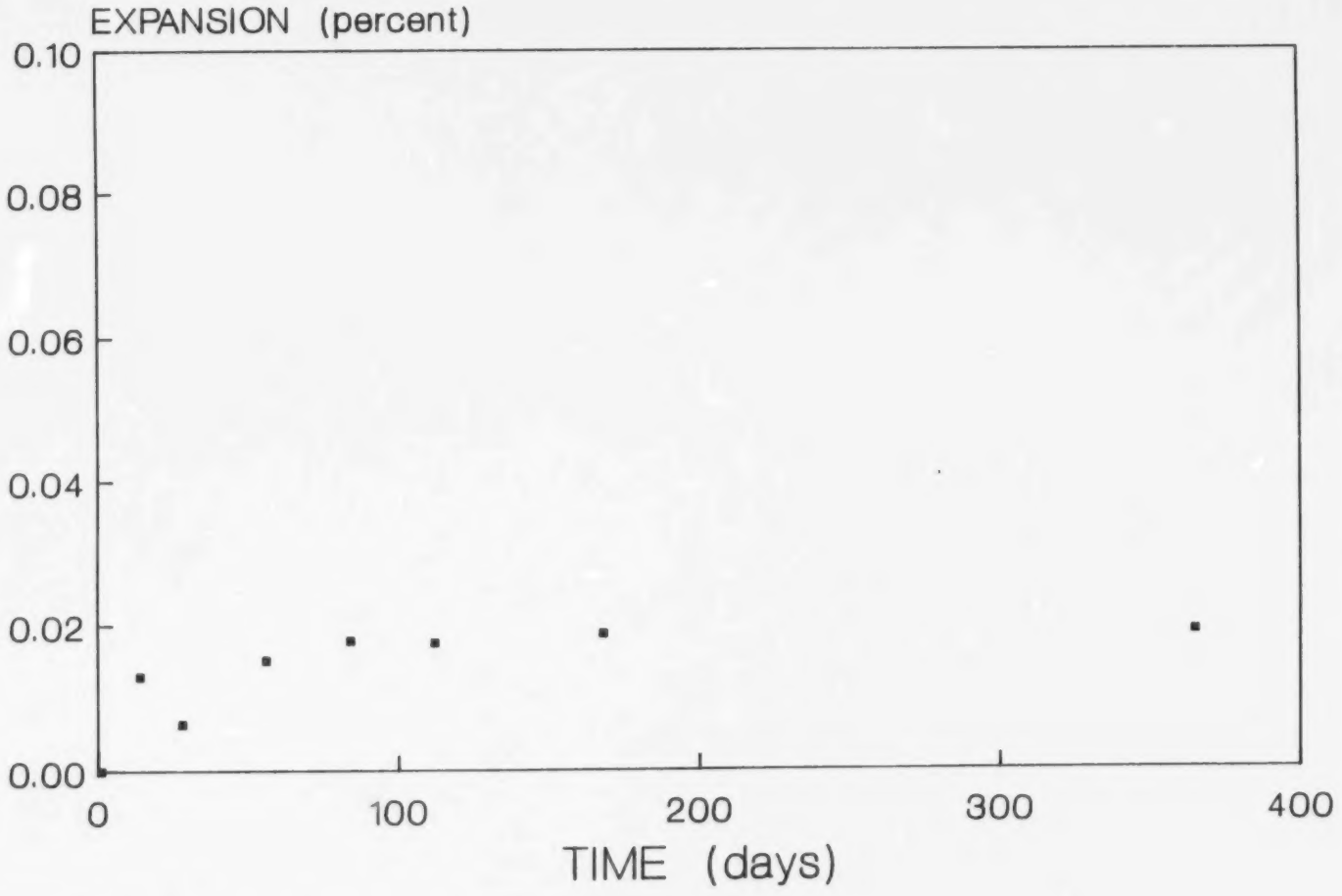
Flow —— 120

	1	2	3	4
INITIAL SAMPLE LENGTH (mm) —	249.31	245.919	246.24	246.55

DATE (DD-MM-YY)	AGE (days)	GAUGE READING (mm) 1	2	3	4	LENGTH CHANGE (mm) 1	2	3	4	PERCENT EXPANSION 1	2	3	4	AVERAGE EXPANSION %
88-06-01	1	-7.295	-9.686	-9.365	-9.048	0	0	0	0	0.000	0.000	0.000	0.000	0.000
88-06-14	14	-7.277	-9.667	-9.343	-9.03	0.018	0.019	0.022	0.018	0.007	0.008	0.009	0.007	0.008
88-06-28	28	-7.274	-9.663	-9.343	-9.03	0.021	0.023	0.022	0.018	0.008	0.009	0.009	0.007	0.009
88-07-26	56	-7.269	-9.657	-9.339	-9.019	0.026	0.029	0.025	0.029	0.010	0.012	0.011	0.012	0.011
88-08-23	84	-7.269	-9.651	-9.332	-9.015	0.026	0.035	0.033	0.033	0.010	0.014	0.013	0.013	0.013
88-09-20	112	-7.272	-9.656	-9.335	-9.021	0.023	0.028	0.03	0.027	0.009	0.011	0.012	0.011	0.011
88-11-15	168	-7.275	-9.658	-9.334	-9.02	0.02	0.028	0.031	0.028	0.008	0.011	0.013	0.011	0.011
89-05-31	365	-7.259	-9.647	-9.319	-9.011	0.036	0.039	0.046	0.037	0.014	0.016	0.019	0.015	0.016

ASTM C227, MORTAR BAR METHOD

Nova Scotia Sand & Gravel, Silica Sand



ASTM C227 - MORTAR BAR METHOD

TYPE AND SOURCE OF AGGREGATES : Nova Scotia Sand & Gravel, Silica Sand

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-05-24

STARTING DATE OF TEST : 88-05-25

BATCH QUANTITIES:

CEMENT (g) — 300

FLY ASH (g) - 0

WATER (ml) — 160

SAND (g) —— 675

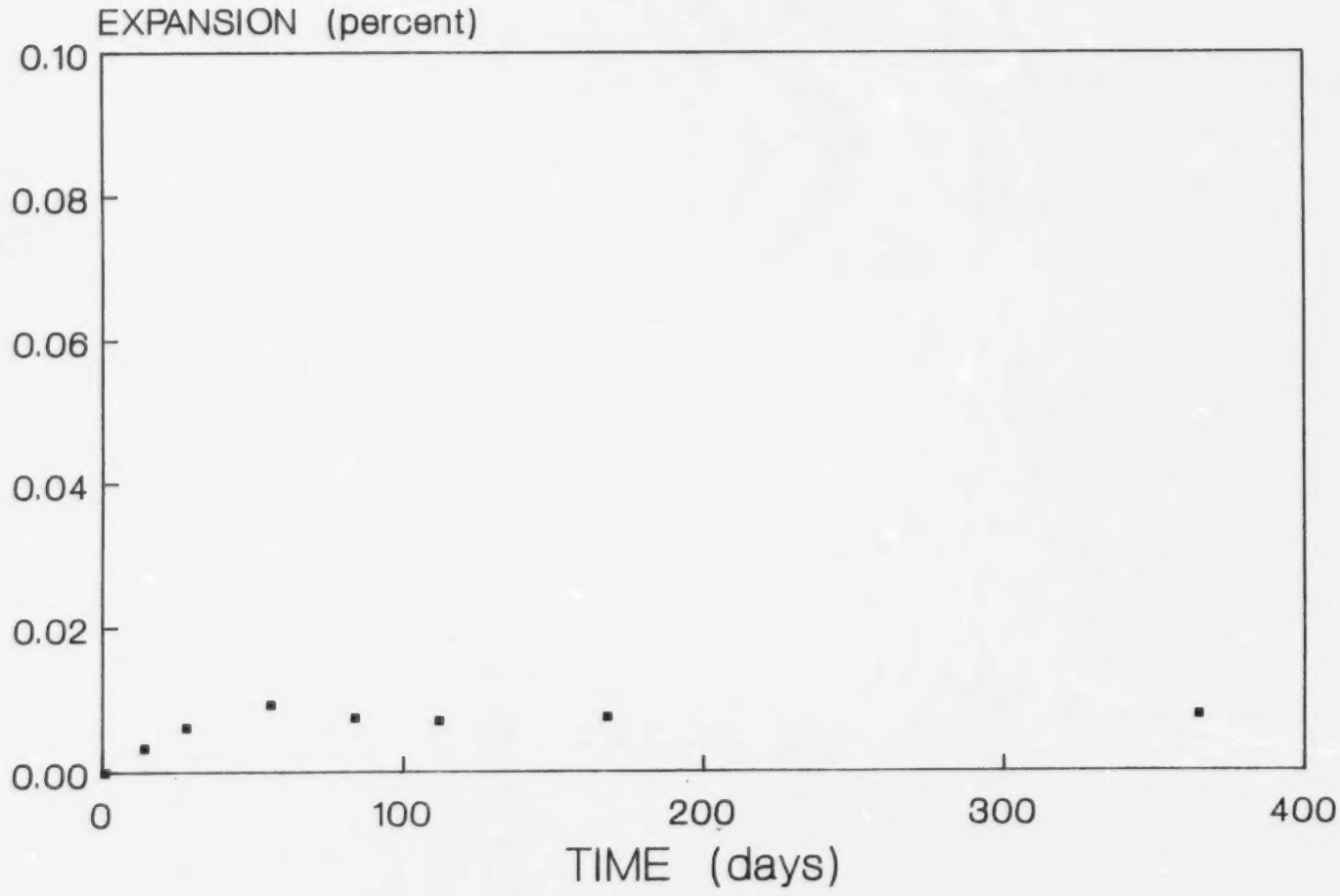
Flow ——— 120

	1	2	3	4
INITIAL SAMPLE LENGTH (mm) —	243.943	244.312	245.586	244.147

DATE (DD-MM-YY)	AGE (days)	GAUGE READING (mm) 1	2	3	4	LENGTH CHANGE (mm) 1	2	3	4	PERCENT EXPANSIO 1	2	3	4	AVERAGE EXPANSION %
88-05-25	1	-11.662	-11.293	-10.019	-11.458	0	0	0	0	0.000	0.000	0.000	0.000	0.000
88-06-07	14	-11.637	-11.256	-9.981	-11.431	0.025	0.037	0.038	0.027	0.010	0.015	0.015	0.011	0.013
88-06-21	28	-11.653	-11.27	-10.001	-11.445	0.009	0.023	0.018	0.013	0.004	0.009	0.007	0.005	0.006
88-07-19	56	-11.633	-11.253	-9.976	-11.422	0.029	0.04	0.043	0.036	0.012	0.016	0.018	0.015	0.015
88-08-16	84	-11.623	-11.248	-9.974	-11.413	0.039	0.045	0.045	0.045	0.016	0.018	0.018	0.018	0.018
88-09-14	112	-11.623	-11.25	-9.974	-11.414	0.039	0.043	0.045	0.044	0.016	0.018	0.018	0.018	0.017
88-11-08	168	-11.622	-11.246	-9.97	-11.411	0.04	0.047	0.049	0.047	0.016	0.019	0.020	0.019	0.019
89-05-24	365	-11.62	-11.248	-9.976	-11.402	0.042	0.045	0.043	0.056	0.017	0.018	0.018	0.023	0.019

ASTM C227 - MORTAR BAR METHOD

Yarmouth Concrete & Gravel, Sand



ASTM C227 - MORTAR BAR METHOD

TYPE AND SOURCE OF AGGREGATES : Yarmouth Concrete & Gravel, Fine Aggregate

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.80 %

DATE BATCHED : 88-05-01

STARTING DATE OF TEST : 88-05-02

BATCH QUANTITIES:

CEMENT (g) — 300

FLY ASH (g) - 0

WATER (ml) — 152

SAND (g) —— 675

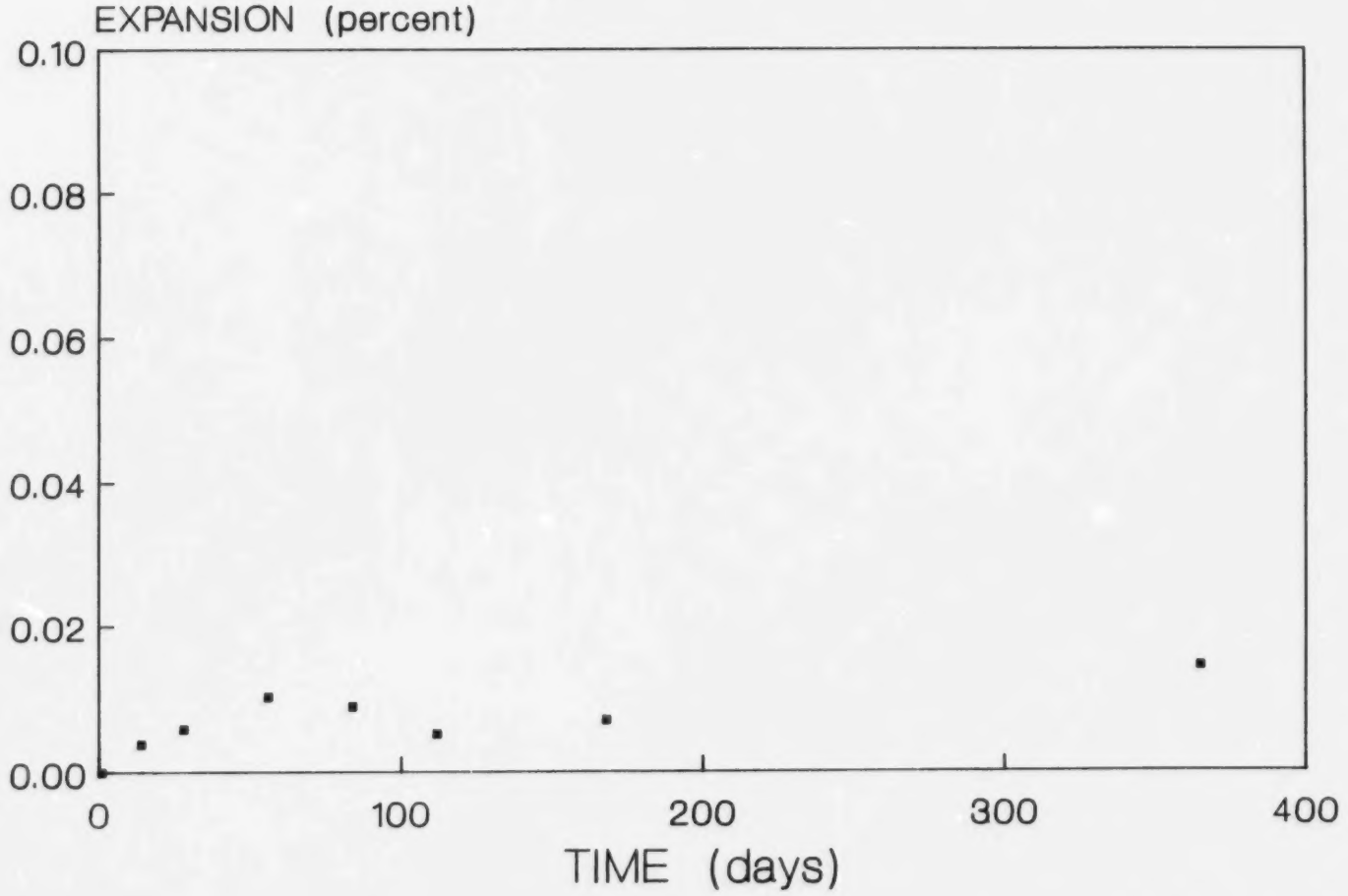
Flow ——— 108

	1	2	3	4
INITIAL SAMPLE LENGTH (mm) —	246.177	246.329	246.42	247.483

DATE (DD-MM-YY)	AGE (days)	GAUGE READING (mm) 1	2	3	4	LENGTH CHANGE (mm) 1	2	3	4	PERCENT EXPANSION 1	2	3	4	AVERAGE EXPANSION %
88-05-02	1	-9.428	-9.276	-9.186	-8.131	0	0	0	0	0.000	0.000	0.000	0.000	0.000
88-05-15	14	-9.419	-9.264	-9.182	-8.122	0.009	0.012	0.003	0.009	0.004	0.005	0.001	0.004	0.003
88-05-29	28	-9.413	-9.258	-9.174	-8.114	0.015	0.018	0.011	0.017	0.006	0.007	0.004	0.007	0.006
88-07-27	56	-9.403	-9.249	-9.168	-8.108	0.025	0.027	0.017	0.023	0.010	0.011	0.007	0.009	0.009
88-08-24	84	-9.412	-9.26	-9.167	-8.107	0.016	0.016	0.018	0.024	0.006	0.006	0.007	0.010	0.007
88-09-21	112	-9.408	-9.251	-9.177	-8.114	0.02	0.025	0.008	0.017	0.008	0.010	0.003	0.007	0.007
88-11-16	168	-9.411	-9.255	-9.167	-8.112	0.017	0.021	0.018	0.019	0.007	0.009	0.007	0.008	0.008
89-05-01	365	-9.401	-9.246	-9.193	-8.103	0.027	0.03	-0.008	0.028	0.011	0.012	-0.003	0.011	0.008

ASTM C227 - MORTAR BAR METHOD

Maurices Pit



ASTM C227 - MORTAR BAR METHOD

TYPE AND SOURCE OF AGGREGATES : Mauricee Pit

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-05-01

STARTING DATE OF TEST : 88-05-02

BATCH QUANTITIES:

CEMENT (g) — 300

FLY ASH (g) - 0

WATER (ml) — 154

SAND (g) —— 575

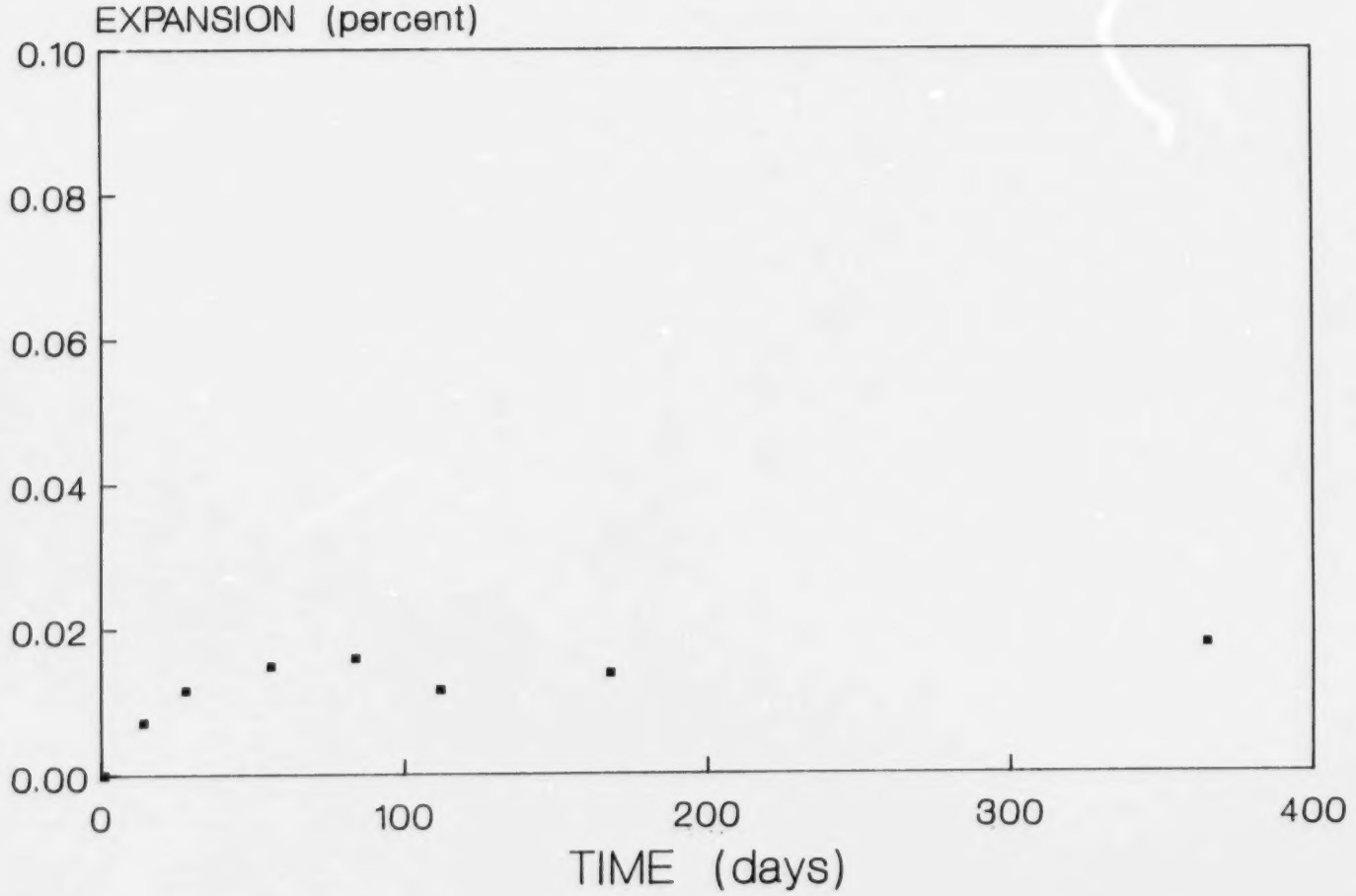
Flow ——— 116

	1	2	3	4
INITIAL SAMPLE LENGTH (mm) —	245.904	246.144	245.30	248.514

DATE	AGE	GAUGE READING (mm)				LENGTH CHANGE (mm)				PERCENT EXPANSION				AVERAGE EXPANSION
(DD-MM-YY)	(days)	1	2	3	4	1	2	3	4	1	2	3	4	%
88-05-02	1	-9.701	-9.461	-10.304	-7.091	0	0	0	0	0.000	0.000	0.000	0.000	0.000
88-05-15	14	-9.683	-9.448	-10.308	-7.08	0.018	0.013	-0.004	0.011	0.007	0.005	-0.002	0.004	0.004
88-05-29	28	-9.677	-9.443	-10.305	-7.074	0.024	0.018	-0.001	0.017	0.010	0.007	0.000	0.007	0.006
88-07-27	56	-9.667	-9.438	-10.269	-7.062	0.034	0.023	0.015	0.029	0.014	0.009	0.006	0.012	0.010
88-08-24	84	-9.669	-9.436	-10.298	-7.064	0.032	0.023	0.006	0.027	0.013	0.009	0.002	0.011	0.009
88-09-21	112	-9.676	-9.442	-10.308	-7.08	0.025	0.019	-0.004	0.011	0.010	0.008	-0.002	0.004	0.005
88-11-15	168	-9.673	-9.44	-10.302	-7.072	0.028	0.021	0.002	0.019	0.011	0.009	0.001	0.008	0.007
89-05-01	365	-9.651	-9.427	-10.282	-7.055	0.05	0.034	0.022	0.036	0.020	0.014	0.009	0.014	0.014

ASTM C227 - MORTAR BAR METHOD

Nova Scotia Sand & Gravel, Coldbrook



ASTM C227 - MORTAR BAR METHOD

TYPE AND SOURCE OF AGGREGATES : Nova Scotia Sand & Gravel, Coldbrook

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.99 %

DATE BATCHED : 88-06-01

STARTING DATE OF TEST : 88-06-02

BATCH QUANTITIES:

CEMENT (g) — 300

FLY ASH (g) - 0

WATER (ml) — 152

SAND (g) —— 675

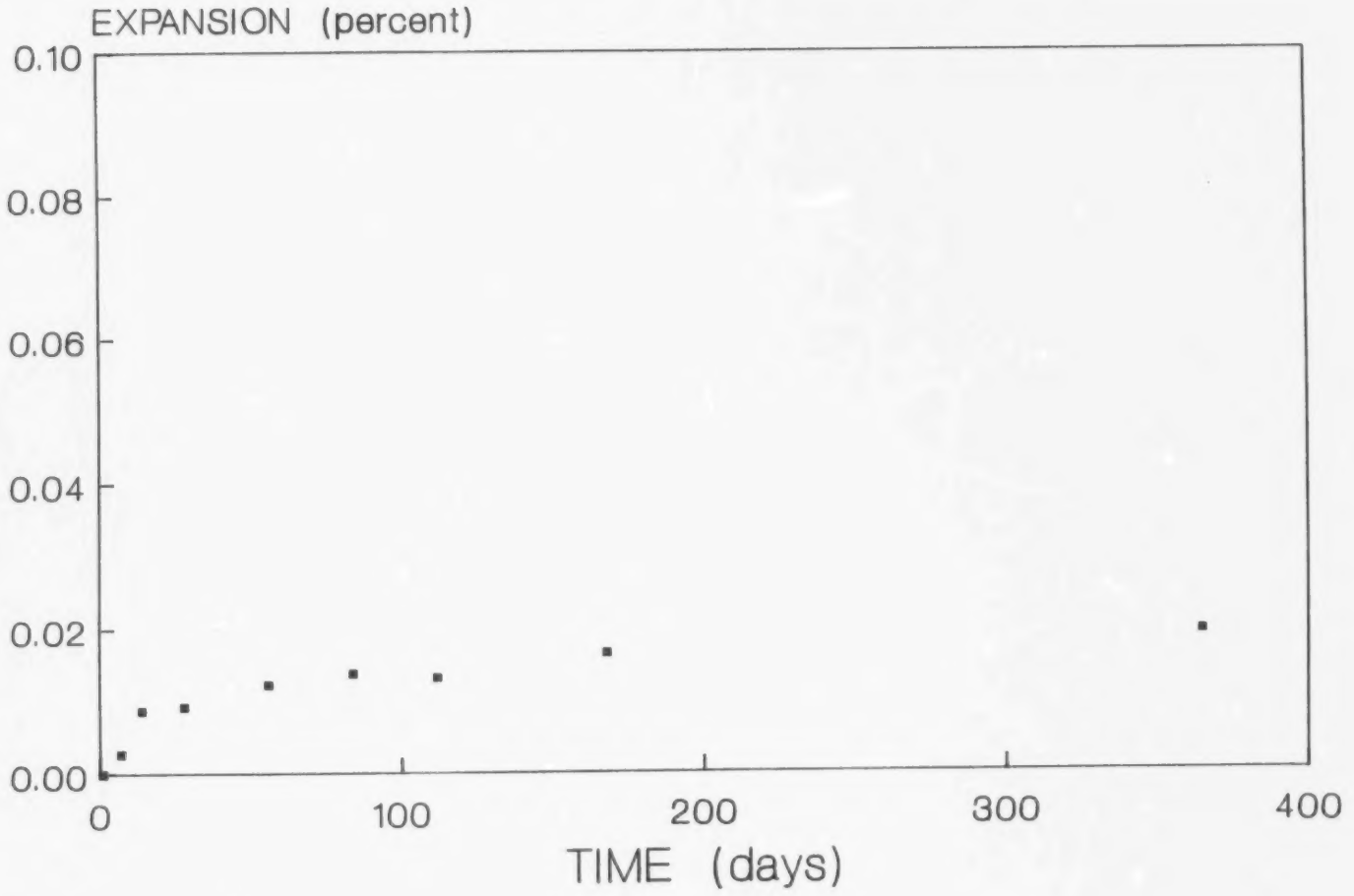
Flow —— 108

	1	2	3	4
INITIAL SAMPLE LENGTH (mm) —	245.487	245.042	245.296	245.25

DATE	AGE	GAUGE READING (mm)				LENGTH CHANGE (mm)				PERCENT EXPANSION				AVERAGE EXPANSION
(DD-MM-YY)	(days)	1	2	3	4	1	2	3	4	1	2	3	4	%
88-06-02	1	-10.118	-10.563	-10.309	-10.348	0	0	0	0	0.000	0.000	0.000	0.000	0.000
88-06-15	14	-10.096	-10.563	-10.285	-10.323	0.022	0	0.024	0.025	0.009	0.000	0.010	0.010	0.007
88-06-29	28	-10.094	-10.53	-10.28	-10.32	0.024	0.033	0.029	0.028	0.010	0.013	0.012	0.011	0.012
88-07-27	56	-10.084	-10.52	-10.278	-10.31	0.034	0.043	0.031	0.038	0.014	0.018	0.013	0.015	0.015
88-08-24	84	-10.078	-10.52	-10.275	-10.308	0.04	0.043	0.034	0.04	0.016	0.018	0.014	0.016	0.016
88-09-21	112	-10.094	-10.532	-10.278	-10.32	0.024	0.031	0.031	0.028	0.010	0.013	0.013	0.011	0.012
88-11-16	168	-10.085	-10.523	-10.278	-10.316	0.033	0.04	0.031	0.032	0.013	0.016	0.013	0.013	0.014
889-06-01	365	-10.076	-10.509	-10.273	-10.305	0.042	0.054	0.036	0.043	0.017	0.022	0.015	0.018	0.018

ASTM C227 - MORTAR BAR METHOD

Spratt Reference Aggregate



ASTM C227 - MORTAR BAR METHOD

TYPE AND SOURCE OF AGGREGATES : Spratt Reference Aggregate, Crushed Coarse Aggregate

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-06-23

STARTING DATE OF TEST : 88-06-24

BATCH QUANTITIES:

CEMENT (g) — 300

FLY ASH (g) - 0

WATER (ml) — 182

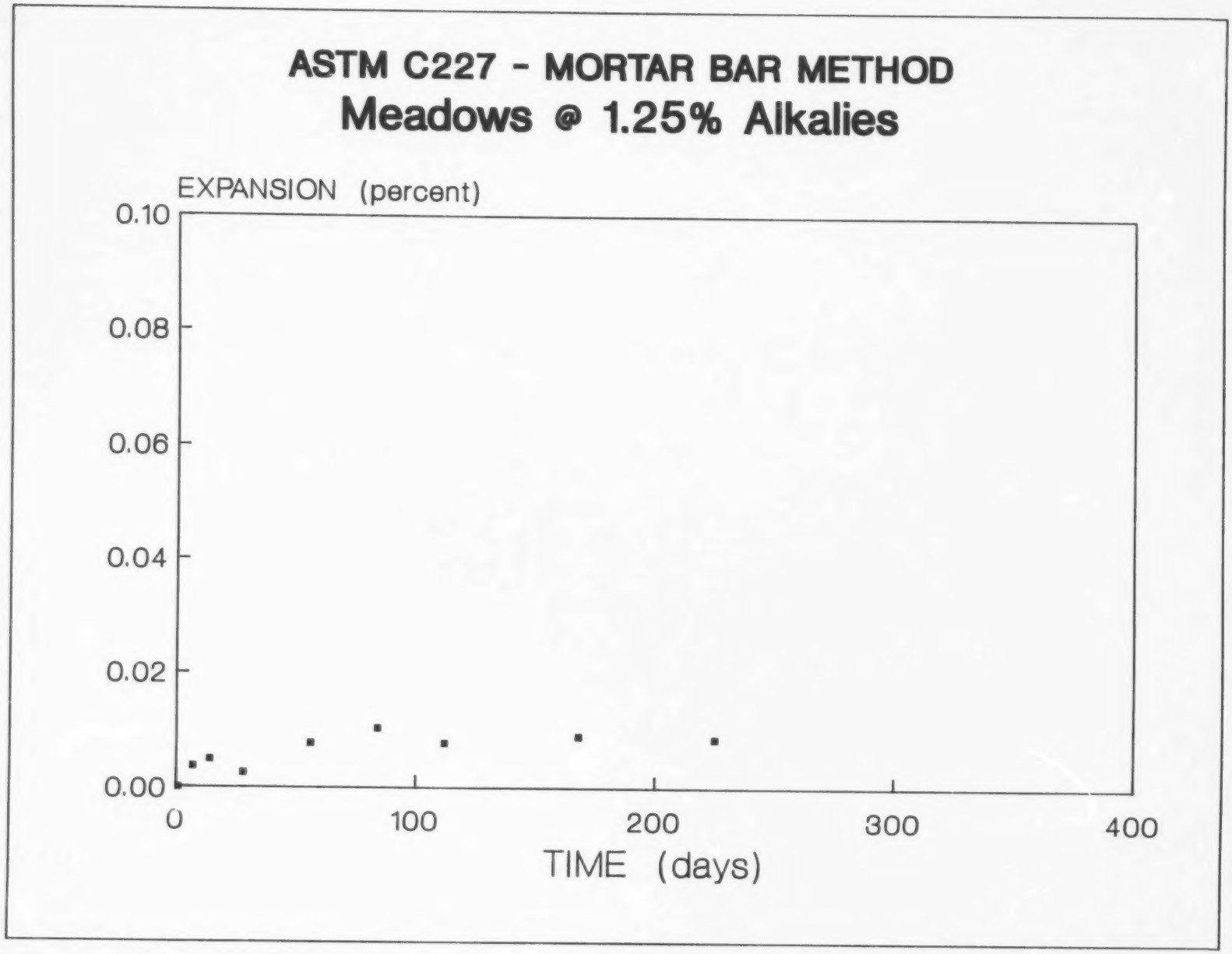
SAND (g) —— 675

Flow —— 105

	1	2	3	4
INITIAL SAMPLE LENGTH (mm) —	245.129	246.359	247.134	247.213

DATE (DD-MM-YY)	AGE (days)	GAUGE READING (mm) 1	2	3	4	LENGTH CHANGE (mm) 1	2	3	4	PERCENT EXPANSION 1	2	3	4	AVERAGE EXPANSION %
88-06-24	1	-10.476	-9.246	-8.471	-8.392	0	0	0	0	0.000	0.000	0.000	0.000	0.000
88-06-30	7	-10.469	-9.238	-8.467	-8.384	0.007	0.008	0.004	0.008	0.003	0.003	0.002	0.003	0.003
88-07-07	14	-10.455	-9.226	-8.451	-8.367	0.021	0.02	0.02	0.025	0.009	0.008	0.008	0.010	0.009
88-07-21	28	-10.453	-9.223	-8.451	-8.367	0.023	0.023	0.02	0.025	0.009	0.009	0.008	0.010	0.009
88-08-18	56	-10.445	-9.22	-8.44	-8.359	0.031	0.026	0.031	0.033	0.013	0.011	0.013	0.013	0.012
88-09-15	84	-10.441	-9.217	-8.436	-8.355	0.035	0.029	0.035	0.037	0.014	0.012	0.014	0.015	0.014
88-10-14	112	-10.444	-9.215	-8.439	-8.357	0.032	0.031	0.032	0.035	0.013	0.013	0.013	0.014	0.013
88-12-08	168	-10.436	-9.206	-8.428	-8.352	0.04	0.04	0.043	0.04	0.016	0.016	0.017	0.016	0.017
89-06-23	365	-10.425	-9.2	-8.421	-8.347	0.051	0.046	0.05	0.045	0.021	0.019	0.020	0.018	0.019

APPENDIX 4


ASTM C227 - MORTAR BAR METHOD
Meadows @ 1.25% Alkalies
EXPANSION (percent)
0.10
0.08
0.06
0.04
0.02
0.00
0
100
200
300
400
TIME (days)

ASTM C227 – MORTAR BAR METHOD

TYPE AND SOURCE OF AGGREGATES : Meadows Fine Aggregate

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 89-02-14

STARTING DATE OF TEST : 89-02-15

BATCH QUANTITIES:

CEMENT (g) — 600

FLY ASH (g) - 0

WATER (ml) — 330

SAND (g) — 1350

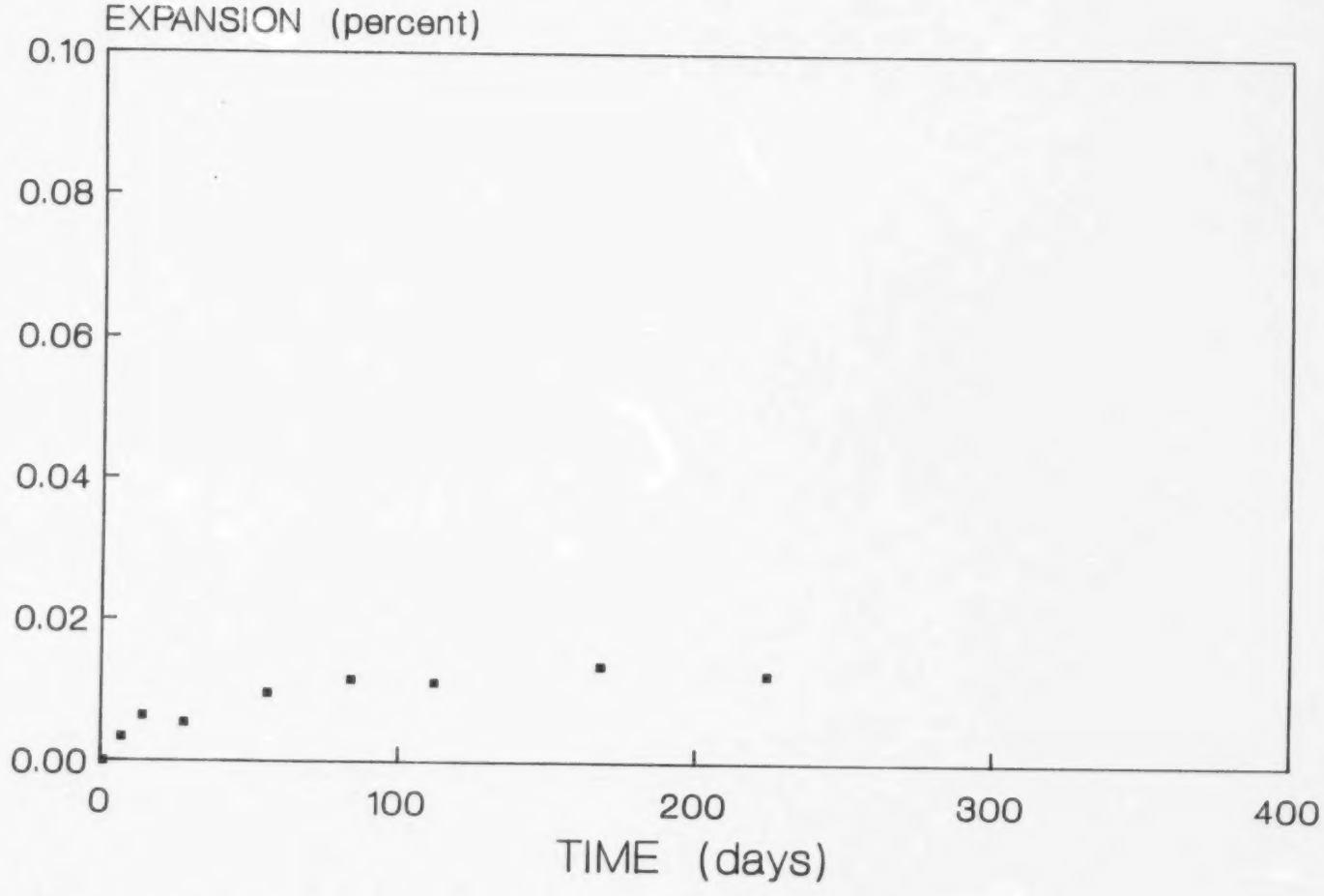
Flow — 128

NaOH (g) — 2.80

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	244.3	244.902	244.013

DATE (DD-MM-YY)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
89-02-15	1	-11.306	-10.704	-11.583	0	0	0	0.000	0.000	0.000	0.000
89-02-21	7	-11.3	-10.692	-11.564	0.006	0.012	0.009	0.002	0.005	0.004	0.004
89-02-28	14	-11.295	-10.69	-11.562	0.011	0.014	0.011	0.005	0.006	0.005	0.005
89-03-14	28	-11.303	-10.695	-11.566	0.003	0.009	0.007	0.001	0.004	0.003	0.003
89-04-11	56	-11.281	-10.685	-11.58	0.025	0.019	0.013	0.010	0.008	0.005	0.008
89-05-09	84	-11.281	-10.675	-11.571	0.025	0.029	0.022	0.010	0.012	0.009	0.010
89-06-06	112	-11.288	-10.682	-11.576	0.018	0.022	0.017	0.007	0.009	0.007	0.008
89-06-01	168	-11.285	-10.68	-11.572	0.021	0.024	0.021	0.009	0.010	0.009	0.009
89-09-26	225	-11.285	-10.681	-11.574	0.021	0.023	0.019	0.009	0.009	0.008	0.009

ASTM C227 - MORTAR BAR METHOD
Orangedale @ 1.25% Alkalies



ASTM C227 - MORTAR BAR METHOD

TYPE AND SOURCE OF AGGREGATES : Orangedale Fine Aggregate

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 89-02-14

STARTING DATE OF TEST : 89-02-15

BATCH QUANTITIES:

CEMENT (g) — 600

FLY ASH (g) - 0

WATER (ml) — 330

SAND (g) — 1350

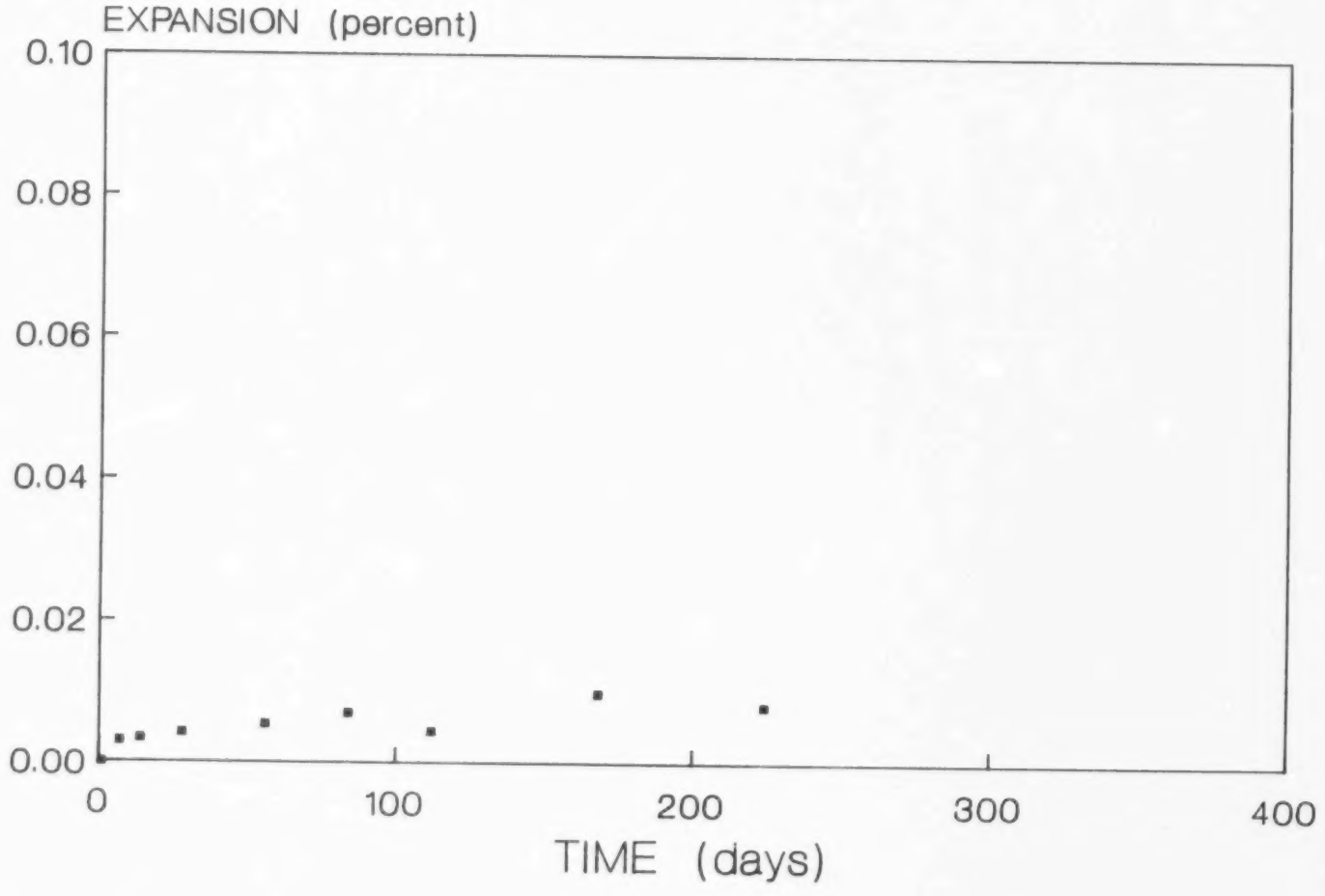
Flow —— 131

NaOH (g) —— 2.80

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	245.702	244.953	245.356

DATE (DD-MM-YY)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
89-02-15	1	-9.904	-10.653	-10.25	0	0	0	0.000	0.000	0.000	0.000
89-02-21	7	-9.895	-10.645	-10.242	0.009	0.008	0.008	0.004	0.003	0.003	0.003
89-02-28	14	-9.889	-10.637	-10.234	0.015	0.016	0.016	0.006	0.007	0.007	0.006
89-03-14	28	-9.889	-10.64	-10.238	0.015	0.013	0.012	0.006	0.005	0.005	0.005
89-04-11	56	-9.882	-10.629	-10.225	0.022	0.024	0.025	0.009	0.010	0.010	0.010
89-05-09	84	-9.874	-10.626	-10.222	0.03	0.027	0.028	0.012	0.011	0.011	0.012
89-06-06	112	-9.875	-10.626	-10.224	0.029	0.027	0.026	0.012	0.011	0.011	0.011
89-08-01	168	-9.87	-10.62	-10.217	0.034	0.033	0.033	0.014	0.013	0.013	0.014
89-09-26	224	-9.874	-10.623	-10.219	0.03	0.03	0.031	0.012	0.012	0.013	0.012

ASTM C227 - MORTAR BAR METHOD
Barneys River @ 1.25% Alkalies



ASTM C227 - MORTAR BAR METHOD

TYPE AND SOURCE OF AGGREGATES : Barneys River Fine Aggregate

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 89-02-14

STARTING DATE OF TEST : 89-02-15

BATCH QUANTITIES:

CEMENT (g) — 600

FLY ASH (g) - 0

WATER (ml) — 330

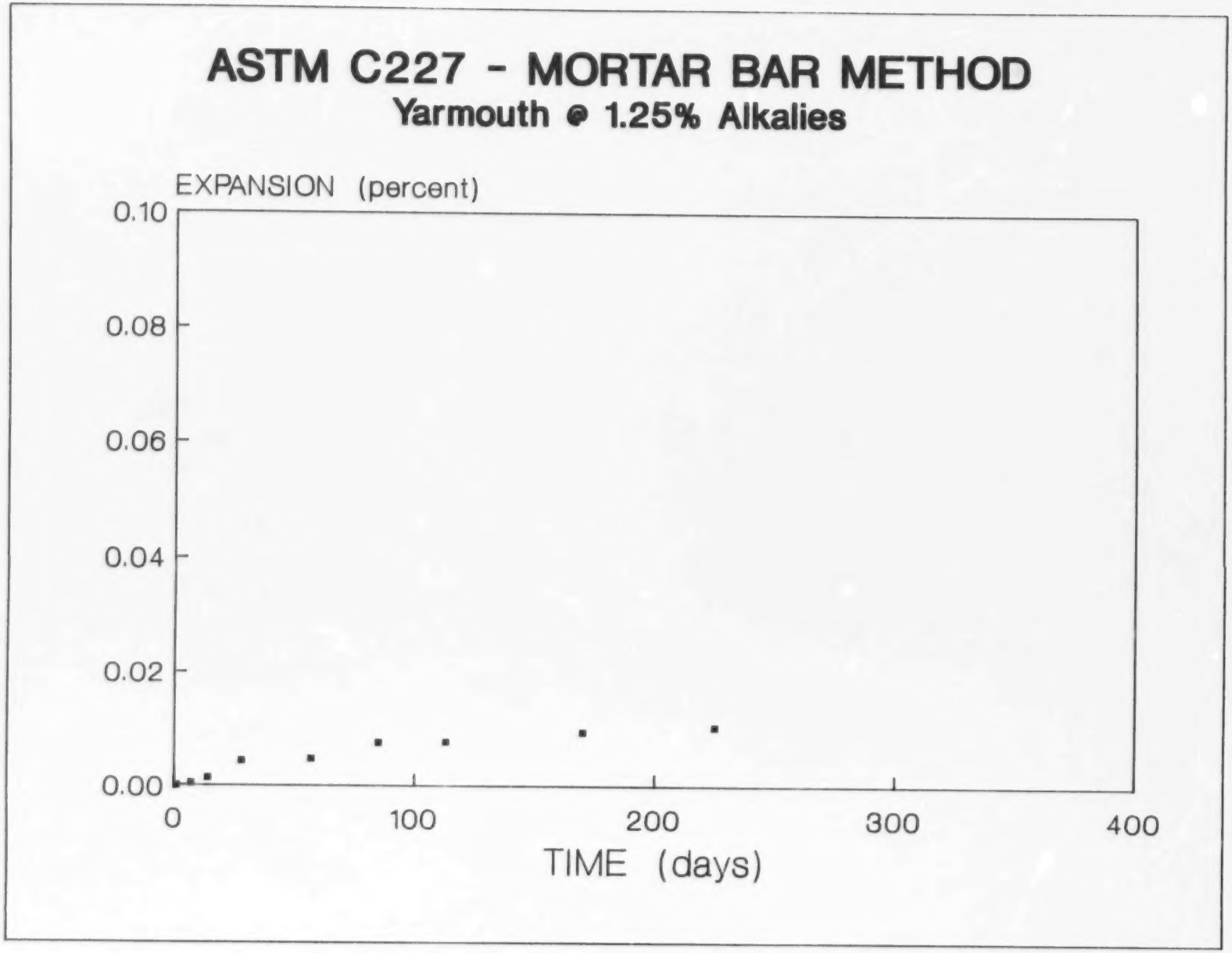
SAND (g) —— 1350

Flow —— 114

NaOH (g) —— 2.80

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	243.659	245.766	246.636

DATE (DD-MM-YY)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
89-02-15	1	-11.947	-9.84	-8.968	0	0	0	0.000	0.000	0.000	0.000
89-02-21	7	-11.944	-9.831	-8.958	0.003	0.009	0.01	0.001	0.004	0.004	0.003
89-02-28	14	-11.943	-9.829	-8.958	0.004	0.011	0.01	0.002	0.004	0.004	0.003
89-03-14	28	-11.946	-9.827	-8.952	0.002	0.013	0.016	0.001	0.005	0.006	0.004
89-04-11	56	-11.941	-9.823	-8.951	0.006	0.017	0.017	0.002	0.007	0.007	0.005
89-05-09	84	-11.936	-9.818	-8.949	0.011	0.022	0.019	0.005	0.009	0.008	0.007
89-06-06	112	-11.939	-9.826	-8.957	0.008	0.014	0.011	0.003	0.006	0.004	0.004
89-08-01	168	-11.926	-9.812	-8.944	0.021	0.028	0.024	0.009	0.011	0.010	0.010
89-09-26	224	-11.931	-9.818	-8.946	0.016	0.022	0.022	0.007	0.009	0.009	0.008


ASTM C227 - MORTAR BAR METHOD
Yarmouth @ 1.25% Alkalies
EXPANSION (percent)
0.10
0.08
0.06
0.04
0.02
0.00
0
100
200
300
400
TIME (days)

ASTM C227 - MORTAR BAR METHOD

TYPE AND SOURCE OF AGGREGATES : Yarmouth Concrete & Gravel Fine Aggregate

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 89-02-20

STARTING DATE OF TEST : 89-02-21

BATCH QUANTITIES:

CEMENT (g) — 600

FLY ASH (g) - 0

WATER (ml) — 330

SAND (g) —— 1350

Flow —— 121

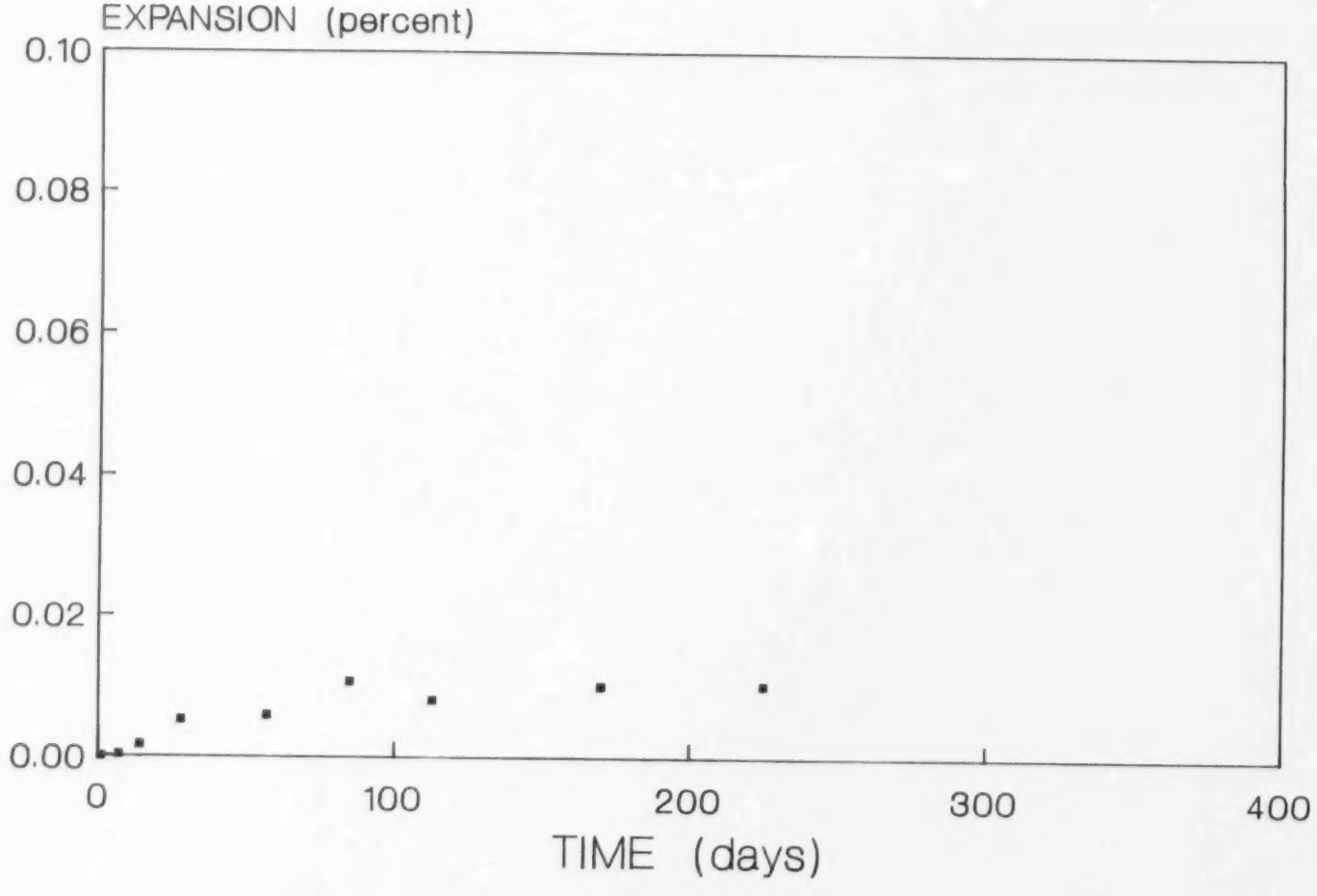
NaOH (g) —— 2.80

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	245.232	245.534	246.221

DATE (DD-MM-YY)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
89-02-21	1	-10.374	-10.072	-9.395	0	0	0	0.000	0.000	0.000	0.000
89-02-28	7	-10.37	-10.074	-9.384	0.004	-0.002	0.001	0.002	-0.001	0.000	0.000
89-03-07	14	-10.37	-10.069	-9.382	0.004	0.003	0.003	0.002	0.001	0.001	0.001
89-03-21	28	-10.361	-10.064	-9.374	0.013	0.008	0.011	0.005	0.003	0.004	0.004
89-04-18	57	-10.363	-10.06	-9.373	0.011	0.012	0.012	0.004	0.005	0.005	0.005
89-05-16	85	-10.353	-10.054	-9.368	0.021	0.018	0.017	0.009	0.007	0.007	0.008
89-06-13	113	-10.351	-10.355	-9.368	0.023	0.017	0.017	0.009	0.007	0.007	0.008
89-08-09	170	-10.349	-10.0499	-9.362	0.025	0.0221	0.023	0.010	0.009	0.009	0.010
89-10-03	225	-10.344	-10.048	-9.362	0.03	0.024	0.023	0.012	0.010	0.009	0.010

ASTM C227 - MORTAR BAR METHOD

Coldbrook @ 1.25% Alkalies



ASTM C227 - MORTAR BAR METHOD

TYPE AND SOURCE OF AGGREGATES : Coldbrook Fine Aggregate

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 89-02-20

STARTING DATE OF TEST : 89-02-21

BATCH QUANTITIES:

CEMENT (g) — 600

FLY ASH (g) - 0

WATER (ml) — 330

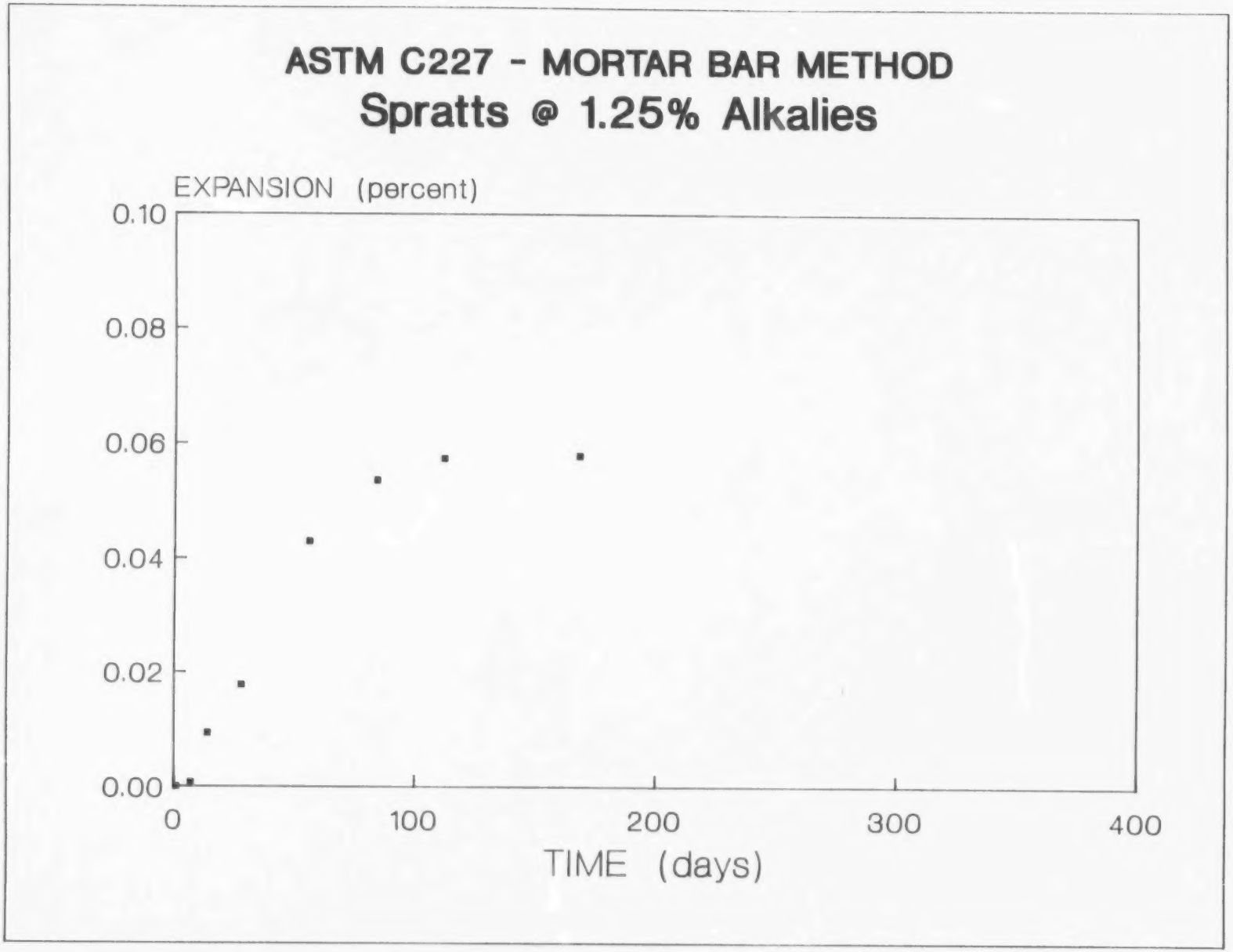
SAND (g) —— 1350

Flow —— 126

NaOH (g) —— 2.80

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	244.633	246.041	244.368

DATE (DD-MM-YY)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
89-02-21	1	-10.973	-9.565	-11.238	0	0	0	0.000	0.000	0.000	0.000
89-02-28	7	-10.975	-9.561	-11.238	-0.002	0.004	0	-0.001	0.002	0.000	0.000
89-03-07	14	-10.97	-9.56	-11.234	0.003	0.005	0.004	0.001	0.002	0.002	0.002
89-03-21	28	-10.961	-9.553	-11.224	0.012	0.012	0.014	0.005	0.005	0.006	0.005
89-04-18	57	-10.959	-9.553	-11.221	0.014	0.012	0.017	0.006	0.005	0.007	0.006
89-05-16	85	-10.945	-9.539	-11.214	0.028	0.026	0.024	0.011	0.011	0.010	0.011
89-06-13	113	-10.953	-9.545	-11.219	0.02	0.02	0.019	0.008	0.008	0.008	0.008
89-08-09	170	-10.948	-9.538	-11.216	0.025	0.027	0.022	0.010	0.011	0.009	0.010
89-10-03	225	-10.948	-9.538	-11.215	0.025	0.027	0.023	0.010	0.011	0.009	0.010


ASTM C227 - MORTAR BAR METHOD
Spratts @ 1.25% Alkalies
EXPANSION (percent)
0.10
0.08
0.06
0.04
0.02
0.00
0
100
200
300
400
TIME (days)

ASTM C227 - MORTAR BAR METHOD

TYPE AND SOURCE OF AGGREGATES : Spratt Reference Aggregate, Crushed Coarse Aggregate

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 89-03-09

STARTING DATE OF TEST : 89-03-10

BATCH QUANTITIES:

CEMENT (g) — 600

FLY ASH (g) - 0

WATER (ml) — 330

SAND (g) —— 1350

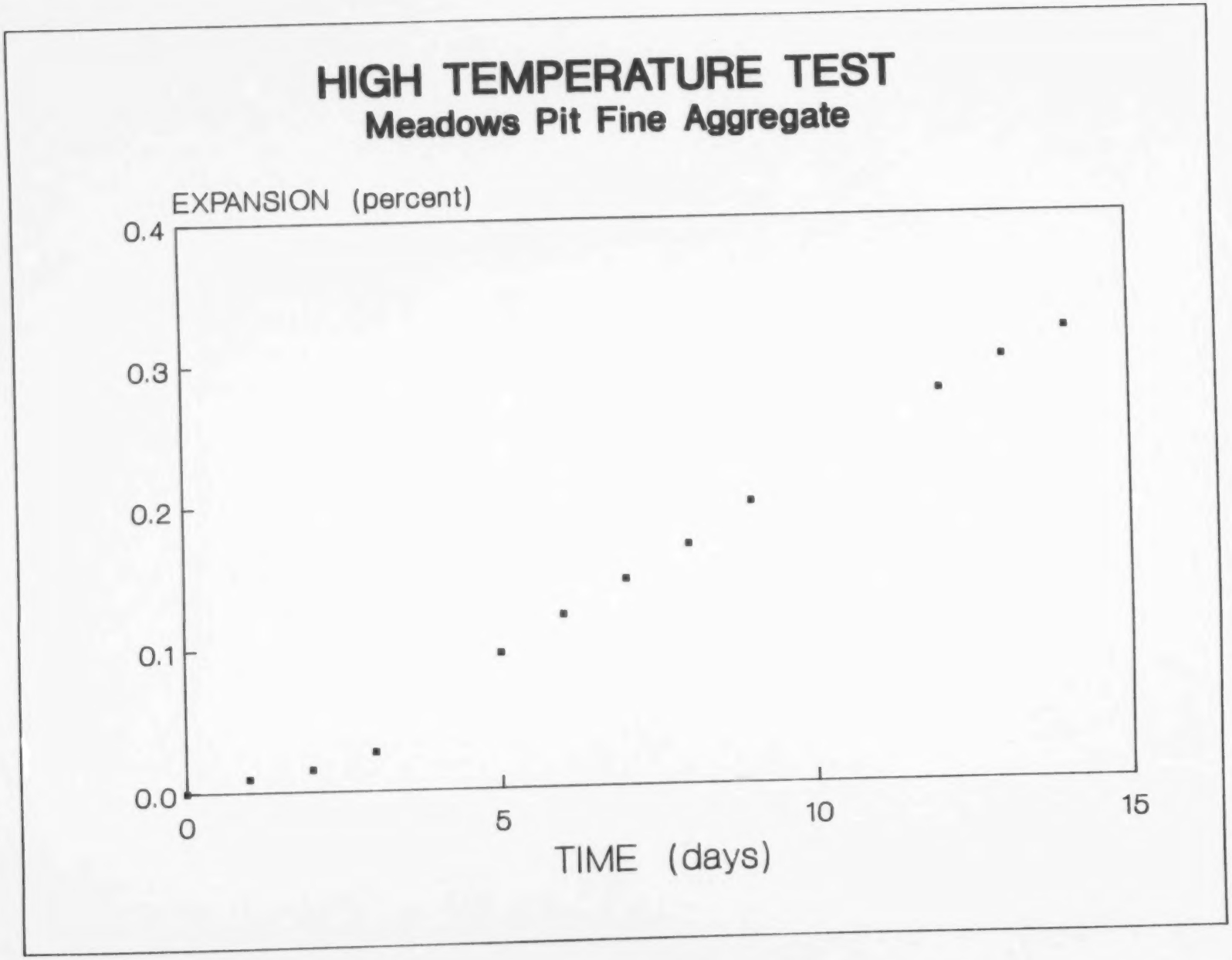
Flow —— 112

NaOH (g) —— 2.80

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	245.037	245.897	246.513

DATE (DD-MM-YY)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
89-03-10	1	-10.569	-9.709	-9.093	0	0	0	0.000	0.000	0.000	0.000
89-03-16	7	-10.564	-9.709	-9.093	0.005	0	0	0.002	0.000	0.000	0.001
89-03-23	14	-10.546	-9.686	-9.07	0.023	0.023	0.023	0.009	0.009	0.009	0.009
89-04-06	28	-10.525	-9.666	-9.049	0.044	0.043	0.044	0.018	0.017	0.018	0.018
89-05-04	56	-10.457	-9.613	-8.984	0.112	0.096	0.109	0.046	0.039	0.044	0.043
89-06-01	84	-10.426	-9.59	-8.96	0.143	0.119	0.133	0.058	0.048	0.054	0.054
89-06-29	112	-10.416	-9.581	-8.951	0.153	0.128	0.142	0.062	0.052	0.058	0.057
89-08-24	168	-10.412	-9.581	-8.951	0.157	0.128	0.142	0.064	0.052	0.058	0.058

APPENDIX 5


HIGH TEMPERATURE TEST
Meadows Pit Fine Aggregate
EXPANSION (percent)
0.4
0.3
0.2
0.1
0.0
0
5
10
15
TIME (days)

HIGH TEMPERATURE TEST

TYPE AND SOURCE OF AGGREGATES : Meadows Pit, Concrete Sand

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 89-02-06

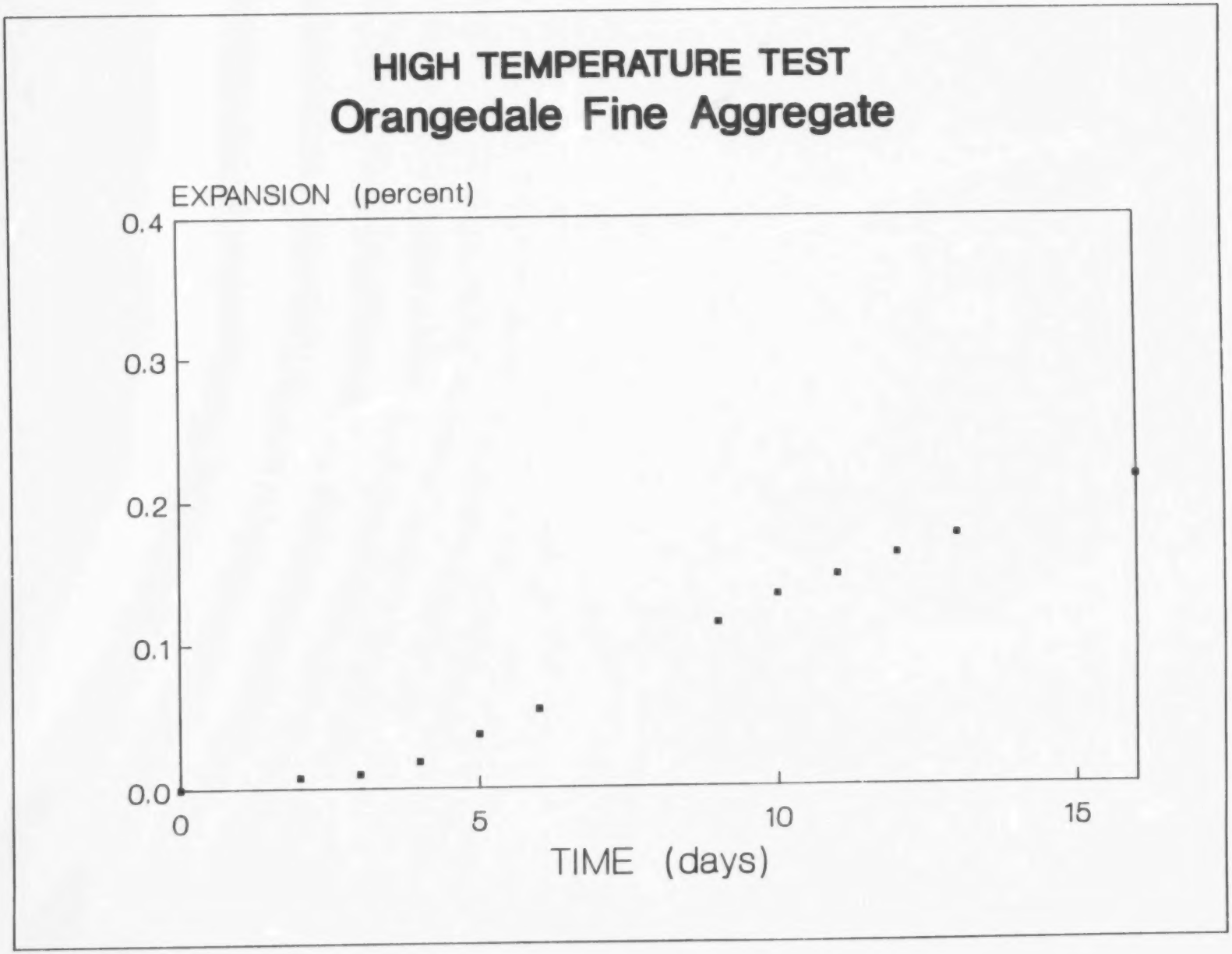
STARTING DATE OF TEST : 89-02-08

BATCH QUANTITIES:

CEMENT (g) —	600
FLY ASH (g) -	0
WATER (ml) —	330
SAND (g) —	1350
Flow —	108

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	246.135	246.134	245.691

DATE (YY-MM-DD)	AGE (DAYS)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
89-02-08	0	-9.47	-9.471	-9.914	0	0	0	0.000	0.000	0.000	0.000
89-02-09	1	-9.445	-9.45	-9.89	0.025	0.021	0.024	0.010	0.009	0.010	0.009
89-02-10	2	-9.423	-9.432	-9.865	0.047	0.039	0.029	0.019	0.016	0.012	0.016
89-02-11	3	-9.394	-9.403	-9.854	0.076	0.068	0.06	0.031	0.028	0.024	0.028
89-02-13	5	-9.230	-9.229	-9.693	0.24	0.242	0.221	0.098	0.098	0.090	0.095
89-02-14	6	-9.172	-9.165	-9.625	0.298	0.306	0.289	0.121	0.124	0.118	0.121
89-02-15	7	-9.110	-9.103	-9.57	0.36	0.368	0.344	0.146	0.150	0.140	0.145
89-02-16	8	-9.048	-9.041	-9.517	0.422	0.43	0.397	0.171	0.175	0.162	0.169
89-02-17	9	-8.976	-8.974	-9.438	0.494	0.497	0.476	0.201	0.202	0.194	0.199
89-02-20	12	-8.790	-8.774	-9.25	0.68	0.697	0.664	0.276	0.283	0.270	0.277
89-02-21	13	-8.747	-8.702	-9.196	0.723	0.769	0.718	0.294	0.312	0.292	0.299
89-02-22	14	-8.68	-8.679	-9.144	0.79	0.792	0.77	0.321	0.322	0.313	0.319


HIGH TEMPERATURE TEST
Orangedale Fine Aggregate
EXPANSION (percent)
0.4
0.3
0.2
0.1
0.0
0
5
10
15
TIME (days)

HIGH TEMPERATURE TEST

TYPE AND SOURCE OF AGGREGATES : Orangedale Concrete Sand

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 89-02-09

STARTING DATE OF TEST : 89-02-11

BATCH QUANTITIES:

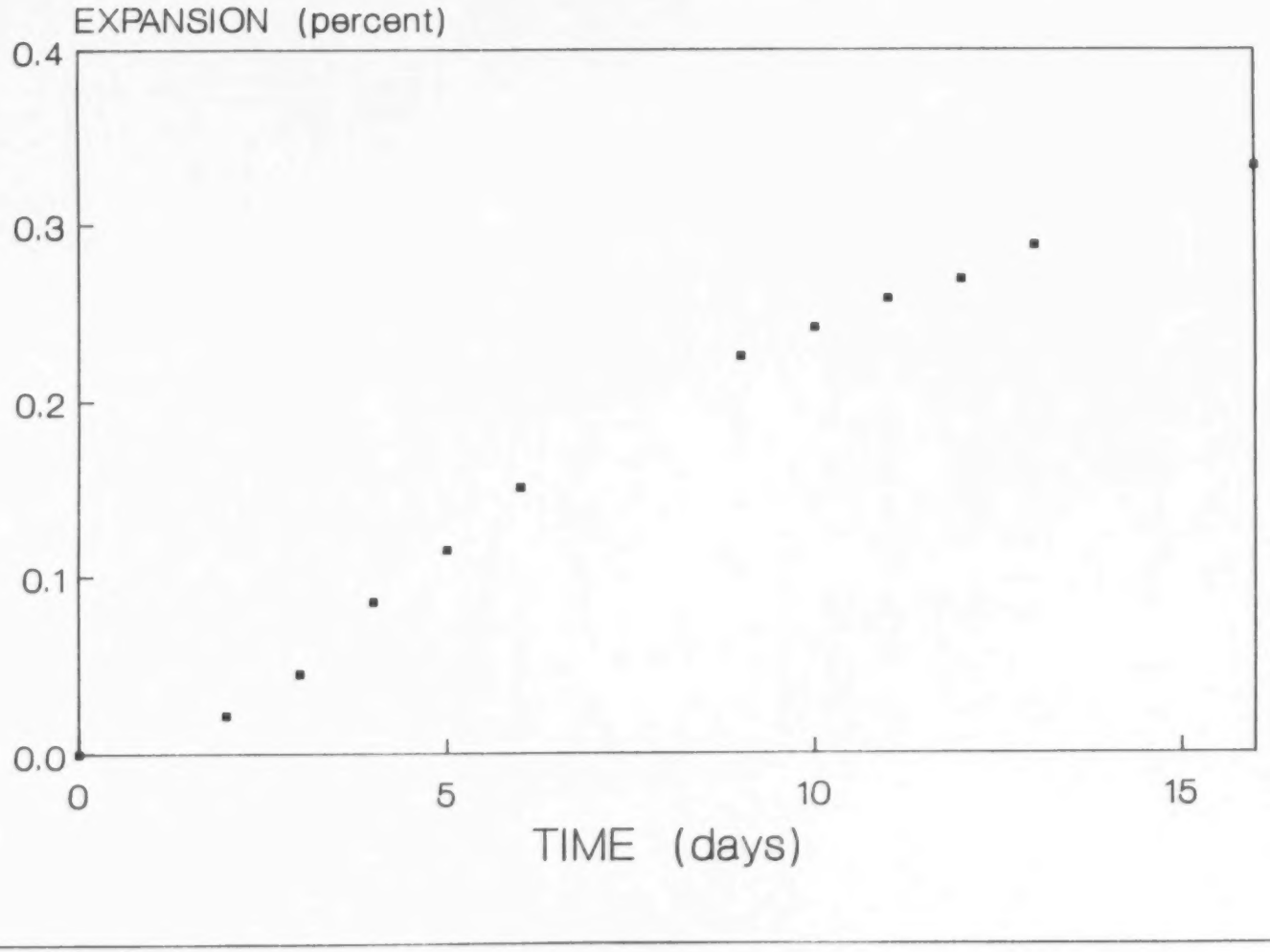
CEMENT (g) —	600
FLY ASH (g) -	0
WATER (ml) —	330
SAND (g) —	1350
Flow ——	106

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	246.886	247.012	245.805

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
89-02-11	0	-8.72	-8.594	-9.801	0	0	0	0.000	0.000	0.000	0.000
89-02-13	2	-8.69	-8.579	-9.789	0.03	0.015	0.012	0.012	0.006	0.005	0.008
89-02-14	3	-8.685	-8.571	-9.784	0.035	0.023	0.017	0.014	0.009	0.007	0.010
89-02-15	4	-8.665	-8.551	-9.762	0.055	0.043	0.039	0.022	0.017	0.016	0.019
89-02-16	5	-8.621	-8.503	-9.716	0.099	0.091	0.085	0.040	0.037	0.035	0.037
89-02-17	6	-8.576	-8.464	-9.674	0.144	0.13	0.127	0.058	0.053	0.052	0.054
89-02-20	9	-8.432	-8.324	-9.517	0.288	0.27	0.284	0.117	0.109	0.116	0.114
89-02-21	10	-8.377	-8.279	-9.469	0.343	0.315	0.332	0.139	0.128	0.135	0.134
89-02-22	11	-8.348	-8.239	-9.438	0.372	0.355	0.363	0.151	0.144	0.148	0.147
89-02-23	12	-8.313	-8.205	-9.397	0.407	0.389	0.404	0.165	0.157	0.164	0.162
89-02-24	13	-8.279	-8.176	-9.361	0.441	0.418	0.44	0.179	0.169	0.179	0.176
89-02-27	16	-8.18	-8.076	-9.264	0.54	0.518	0.537	0.219	0.210	0.218	0.216

HIGH TEMPERATURE TEST

Barneys River Fine Aggregate



HIGH TEMPERATURE TEST

TYPE AND SOURCE OF AGGREGATES : Barney's River, Concrete Sand

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 89-02-09

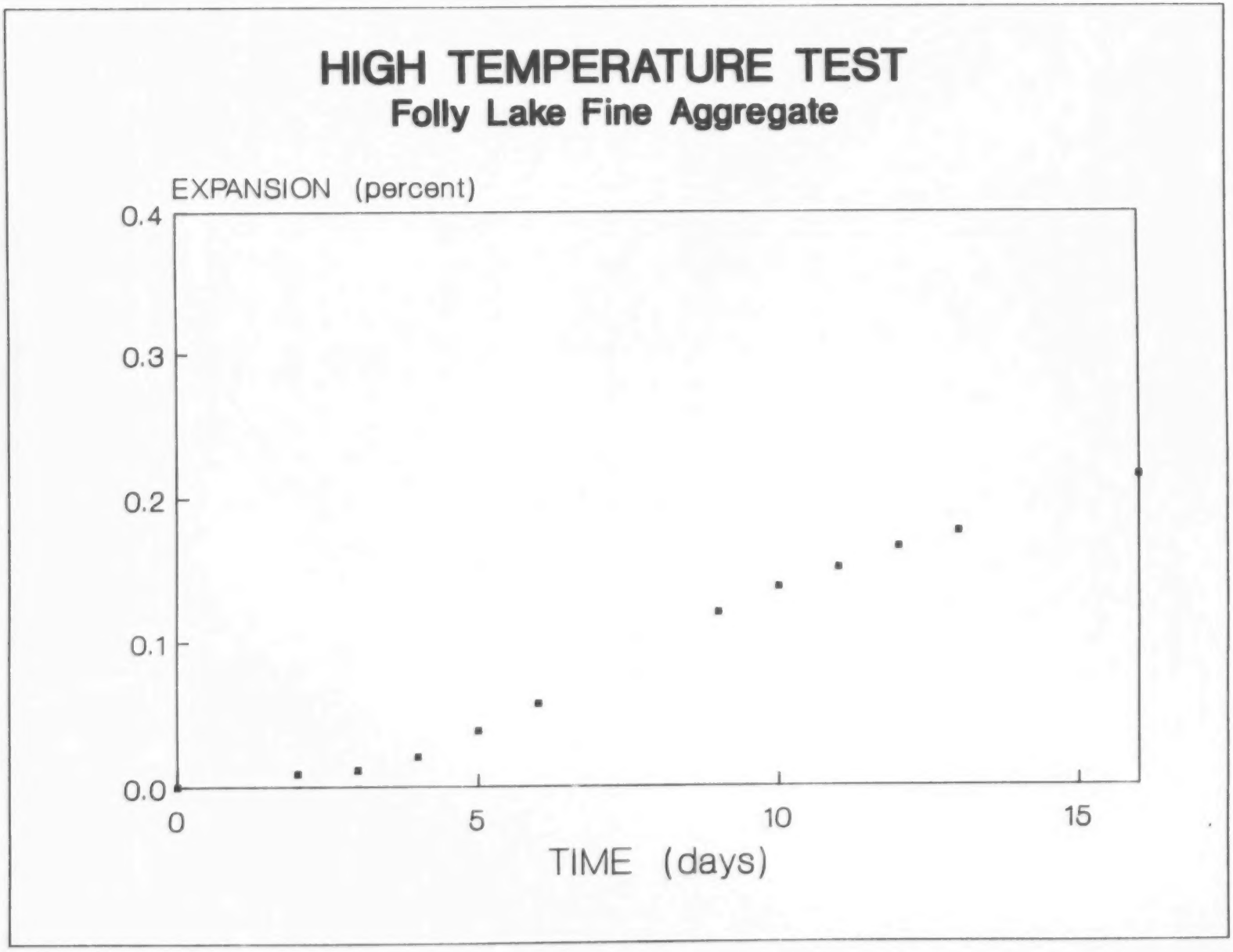
STARTING DATE OF TEST : 89-02-11

BATCH QUANTITIES:

CEMENT (g) —	800
FLY ASH (g) -	0
WATER (ml) —	330
SAND (g) —	1350
Flow —	107

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	246.175	246.845	246.303

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
89-02-11	0	-9.430	-9.76	-9.302	0	0	0	0.000	0.000	0.000	0.000
89-02-13	2	-9.377	-9.703	-9.253	0.053	0.057	0.049	0.022	0.023	0.020	0.022
89-02-14	3	-9.317	-9.643	-9.199	0.113	0.117	0.103	0.046	0.047	0.042	0.045
89-02-15	4	-9.212	-9.546	-9.102	0.218	0.214	0.2	0.089	0.087	0.081	0.085
89-02-16	5	-9.140	-9.473	-9.029	0.29	0.287	0.273	0.118	0.116	0.111	0.115
89-02-17	6	-9.048	-9.385	-8.944	0.382	0.375	0.358	0.155	0.152	0.145	0.151
89-02-20	9	-8.857	-9.204	-8.764	0.573	0.556	0.538	0.233	0.225	0.218	0.225
89-02-21	10	-8.82	-9.164	-8.72	0.61	0.596	0.582	0.248	0.241	0.236	0.242
89-02-22	11	-8.777	-9.122	-8.684	0.653	0.638	0.618	0.265	0.258	0.251	0.258
89-02-23	12	-8.748	-9.097	-8.656	0.682	0.663	0.646	0.277	0.269	0.262	0.269
89-02-24	13	-8.681	-9.05	-8.619	0.749	0.7	0.683	0.304	0.284	0.277	0.288
89-02-27	16	-8.583	-7.944	-8.503	0.847	0.816	0.799	0.344	0.331	0.324	0.333


HIGH TEMPERATURE TEST
Folly Lake Fine Aggregate
EXPANSION (percent)
0.4
0.3
0.2
0.1
0.0
0
5
10
15
TIME (days)

HIGH TEMPERATURE TEST

TYPE AND SOURCE OF AGGREGATES : Folly Lake, Concrete Sand

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 89-02-09

STARTING DATE OF TEST : 89-02-11

BATCH QUANTITIES:

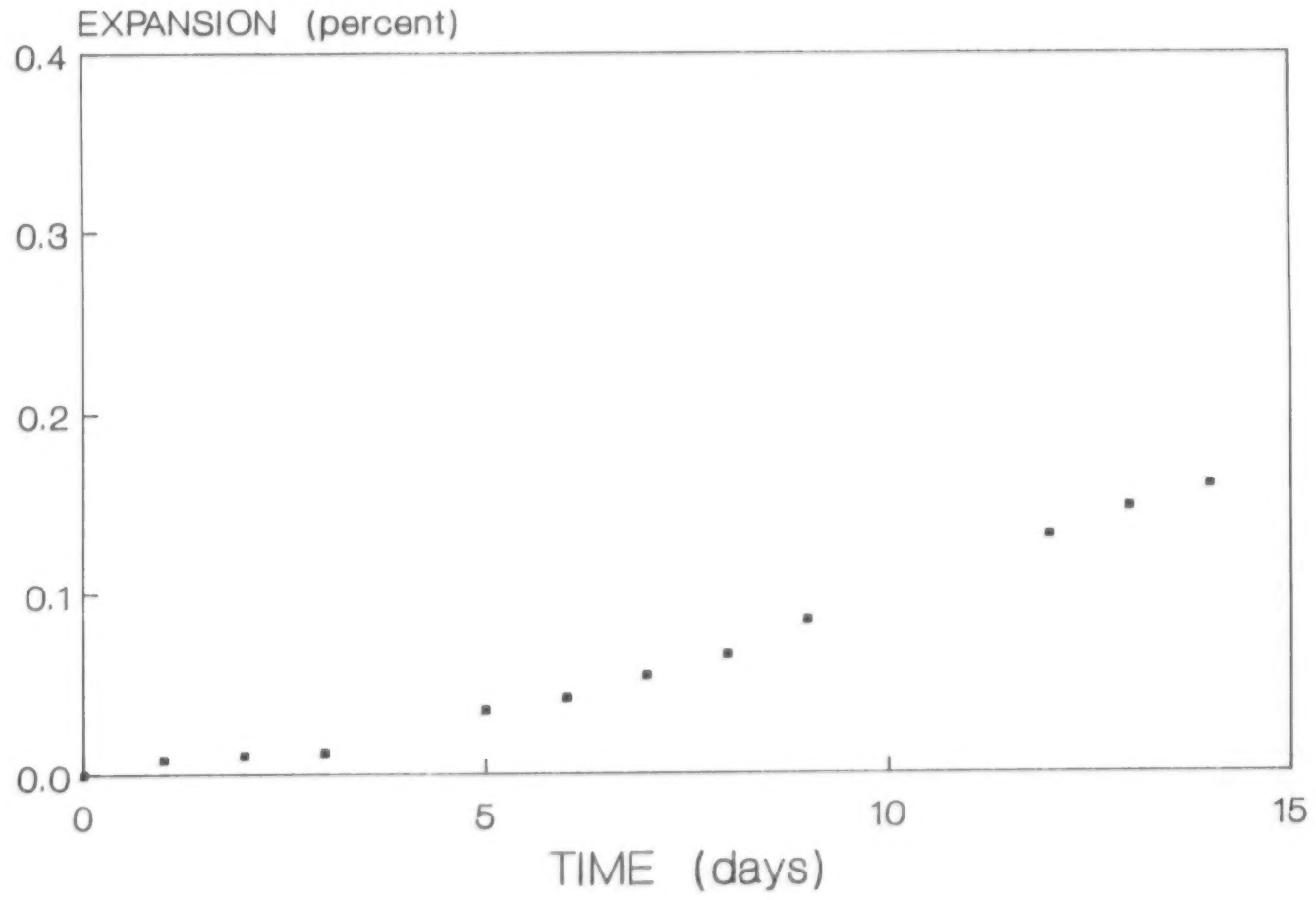
CEMENT (g) —	600
FLY ASH (g) -	0
WATER (ml) —	330
SAND (g) ——	1350
Flow ——	106

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	246.486	246.841	247.085

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
89-02-11	0	-9.119	-9.764	-9.54	0	0	0	0.000	0.000	0.000	0.000
89-02-13	2	-9.093	-9.743	-9.52	0.026	0.021	0.02	0.011	0.009	0.008	0.009
89-02-14	3	-9.088	-9.74	-9.511	0.031	0.024	0.029	0.013	0.010	0.012	0.011
89-02-15	4	-9.067	-9.719	-9.495	0.052	0.045	0.054	0.021	0.018	0.022	0.020
89-02-16	5	-9.012	-9.672	-9.456	0.107	0.092	0.084	0.043	0.037	0.034	0.038
89-02-17	6	-8.975	-9.633	-9.385	0.144	0.131	0.145	0.058	0.053	0.059	0.057
89-02-20	9	-8.821	-9.471	-9.236	0.298	0.293	0.302	0.121	0.119	0.122	0.121
89-02-21	10	-8.777	-9.426	-9.195	0.342	0.338	0.345	0.139	0.137	0.140	0.139
89-02-22	11	-8.743	-9.389	-9.157	0.376	0.385	0.383	0.153	0.148	0.155	0.152
89-02-23	12	-8.706	-9.361	-9.124	0.413	0.403	0.416	0.168	0.164	0.168	0.167
89-02-24	13	-8.679	-9.335	-9.098	0.44	0.429	0.442	0.179	0.175	0.179	0.177
89-02-27	16	-8.567	-9.24	-8	0.532	0.524	0.54	0.216	0.213	0.219	0.216

HIGH TEMPERATURE TEST

Shubenacadie Fine Aggregate



HIGH TEMPERATURE TEST

TYPE AND SOURCE OF AGGREGATES : Nova Scotia Sand & Gravel, Shubenacadie. Concrete Sand

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 89-02-06

STARTING DATE OF TEST : 89-02-08

BATCH QUANTITIES:

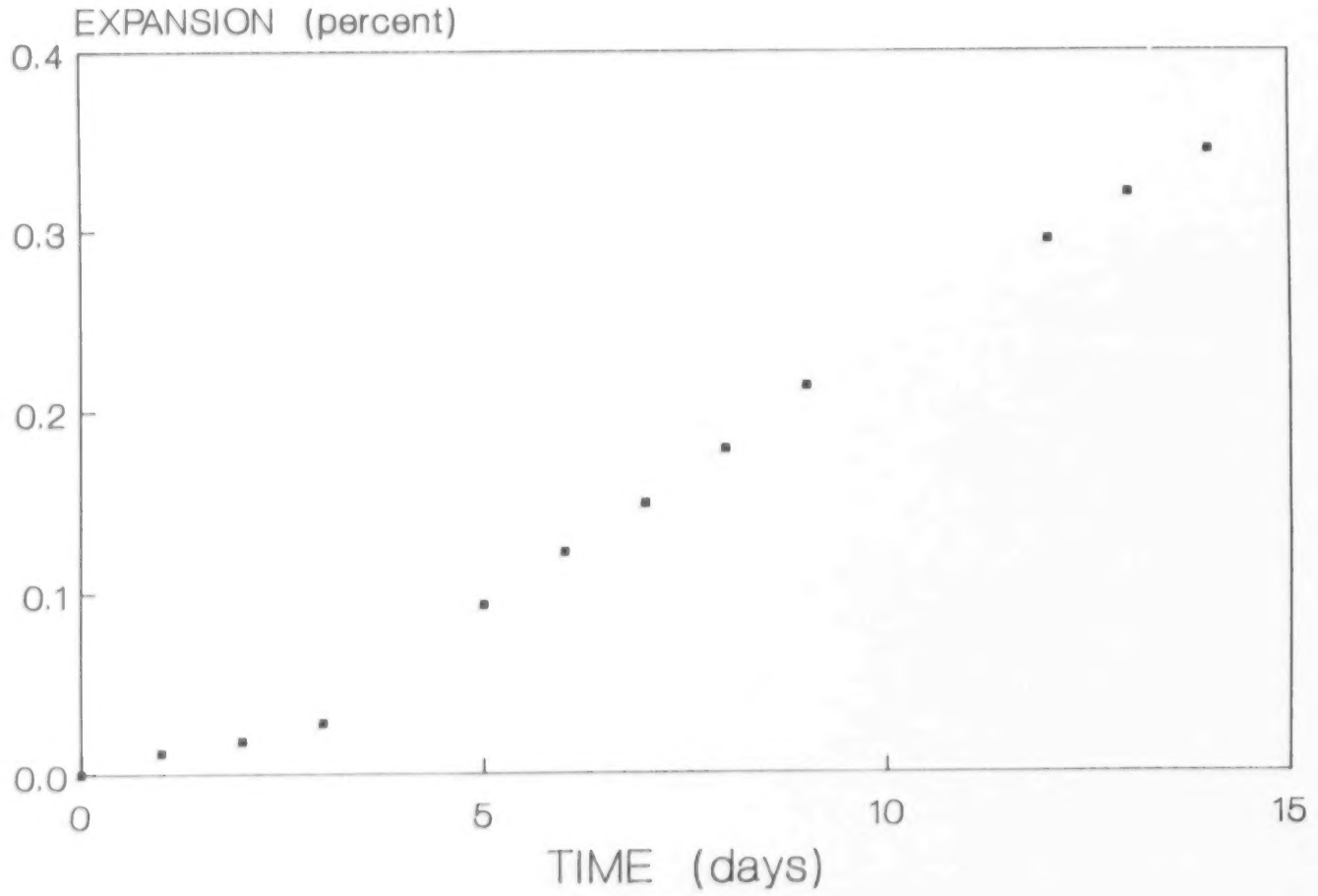
CEMENT (g) —	600
FLY ASH (g) -	0
WATER (ml) —	330
SAND (g) —	1350
Flow ——	108

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	247.186	245.422	245.808

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
89-02-08	0	-9.419	-10.183	-9.707	0	0	0	0.000	0.000	0.000	0.000
89-02-09	1	-9.403	-10.155	-9.691	0.016	0.028	0.016	0.006	0.011	0.007	0.008
89-02-10	2	-9.396	-10.154	-9.682	0.023	0.029	0.025	0.009	0.012	0.010	0.010
89-02-11	3	-9.395	-10.147	-9.678	0.024	0.036	0.029	0.010	0.015	0.012	0.012
89-02-13	5	-9.338	-10.09	-9.621	0.081	0.093	0.086	0.033	0.038	0.035	0.035
89-02-14	6	-9.32	-10.07	-9.608	0.099	0.113	0.099	0.040	0.046	0.040	0.042
89-02-15	7	-9.29	-10.04	-9.579	0.129	0.143	0.128	0.052	0.058	0.052	0.054
89-02-16	8	-9.253	-10.013	-9.564	0.161	0.17	0.153	0.065	0.069	0.062	0.066
89-02-17	9	-9.21	-9.964	-9.507	0.209	0.219	0.2	0.085	0.089	0.081	0.085
89-02-20	12	-9.092	-9.848	-9.366	0.327	0.335	0.319	0.132	0.136	0.130	0.133
89-02-21	13	-9.048	-9.813	-9.352	0.371	0.37	0.355	0.150	0.151	0.144	0.148
89-02-22	14	-9.022	-9.777	-9.322	0.397	0.406	0.385	0.161	0.165	0.157	0.161

HIGH TEMPERATURE TEST

Yarmouth Concrete&Gravel Fine Aggregate



91-01647 Alkali-aggregate reactivity in Nova Scotia : year end report (69157-01-SQ)

MICROLOG 1989/90

2/2

HIGH TEMPERATURE TEST

TYPE AND SOURCE OF AGGREGATES : Yarmouth Concrete & Gravel, Concrete Sand

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 89-02-05

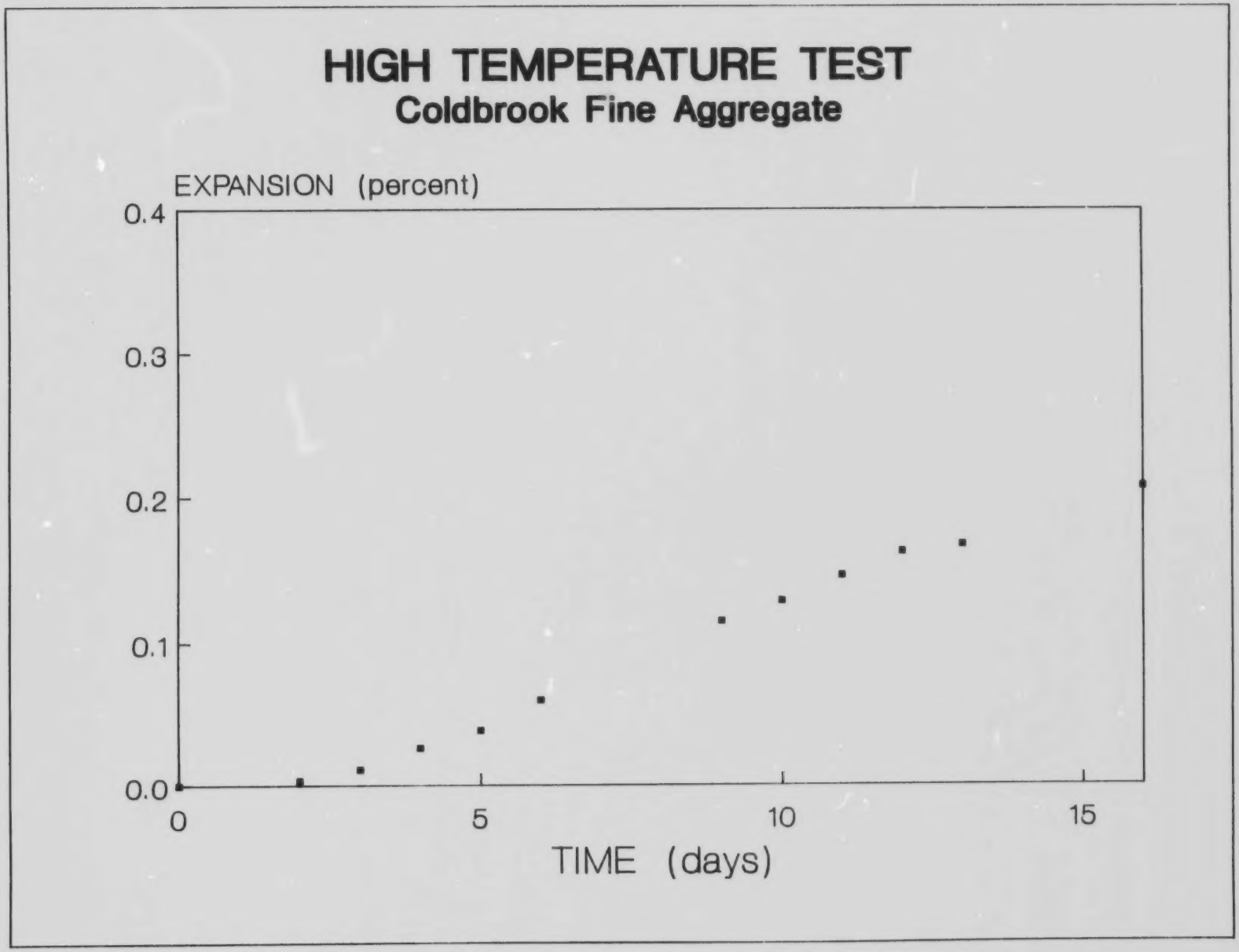
STARTING DATE OF TEST : 89-02-06

BATCH QUANTITIES:

CEMENT (g) —	600
FLY ASH (g) -	0
WATER (ml) —	330
SAND (g) ——	1350
Flow ——	108

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	245.457	246.764	246.318

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
89-02-06	0	-10.148	-8.841	-9.287	0	0	0	0.000	0.000	0.000	0.000
89-02-09	1	-10.112	-8.818	-9.259	0.036	0.023	0.028	0.015	0.009	0.011	0.012
89-02-10	2	-10.096	-8.805	-9.241	0.052	0.036	0.046	0.021	0.015	0.019	0.018
89-02-11	3	-10.077	-8.779	-9.211	0.071	0.062	0.076	0.029	0.025	0.031	0.028
89-02-13	5	-9.907	-8.622	-9.056	0.241	0.219	0.231	0.098	0.089	0.094	0.094
89-02-14	6	-9.843	-8.553	-8.976	0.305	0.288	0.311	0.124	0.117	0.126	0.122
89-02-15	7	-9.774	-8.488	-8.913	0.374	0.353	0.374	0.152	0.143	0.152	0.149
89-02-16	8	-9.694	-8.422	-8.838	0.454	0.419	0.449	0.185	0.170	0.182	0.179
89-02-17	9	-9.604	-8.34	-8.753	0.544	0.501	0.534	0.222	0.203	0.217	0.214
89-02-20	12	-9.400	-8.143	-8.555	0.748	0.698	0.732	0.305	0.283	0.297	0.295
89-02-21	13	-9.335	-8.085	-8.497	0.813	0.756	0.8	0.331	0.306	0.325	0.321
89-02-22	14	-9.272	-8.037	-8.421	0.876	0.804	0.866	0.357	0.326	0.352	0.345


HIGH TEMPERATURE TEST
Coldbrook Fine Aggregate
EXPANSION (percent)
0.4
0.3
0.2
0.1
0.0
0
5
10
15
TIME (days)

HIGH TEMPERATURE TEST

TYPE AND SOURCE OF AGGREGATES : Coldbrook, Keddy Pit, Concrete Sand

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.99 %

DATE BATCHED : 89-02-09

STARTING DATE OF TEST : 89-02-11

BATCH QUANTITIES:

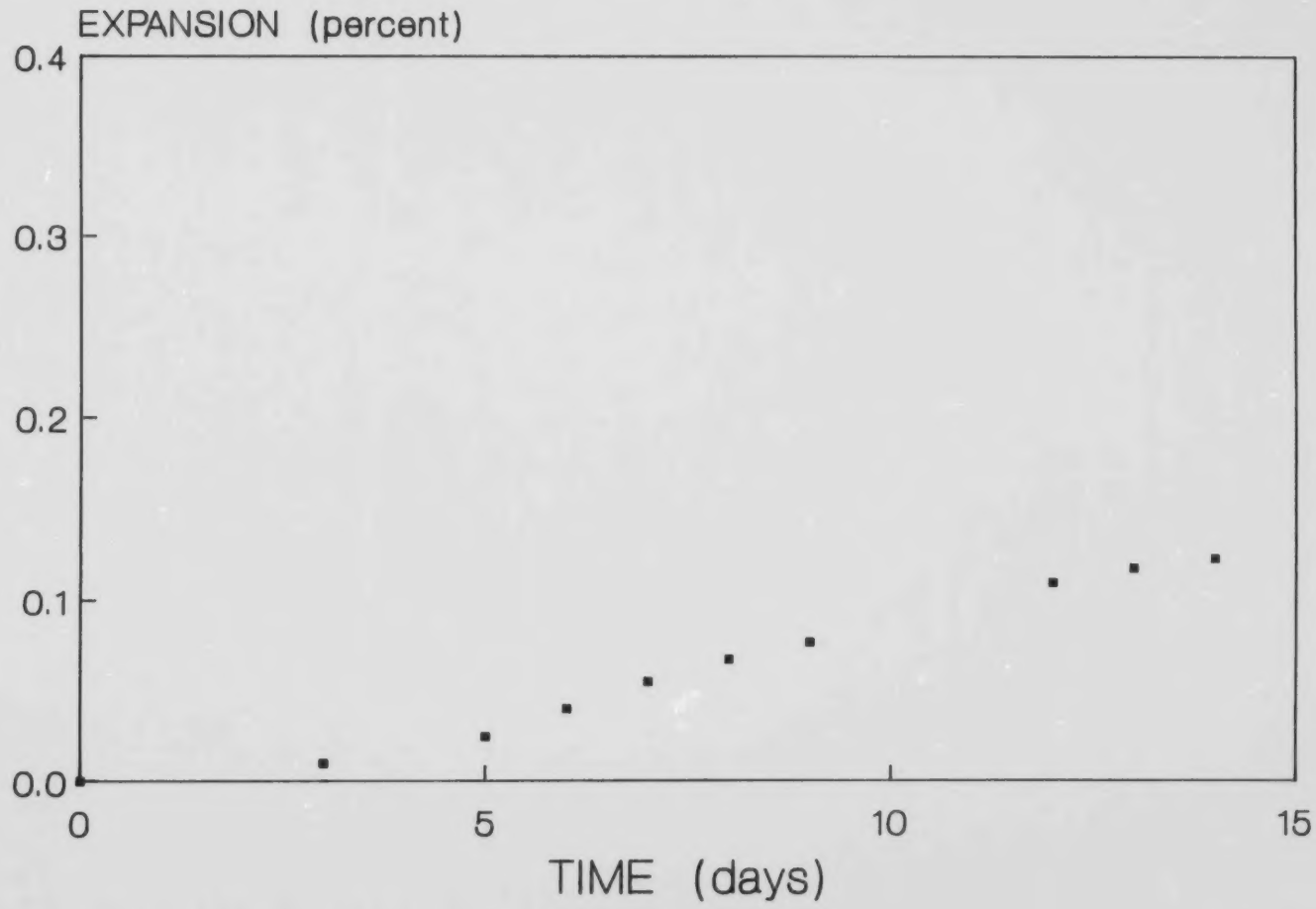
CEMENT (g) —	600
FLY ASH (g) -	0
WATER (ml) —	330
SAND (g) —	1350
Flow —	123

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	246.935	246.403	246.995

DATE (YY-MM-DD)	AGE (DAYS)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
89-02-11	0	-8.670	-9.202	-8.61	0	0	0	0.000	0.000	0.000	0.000
89-02-13	2	-8.662	-9.195	-8.599	0.008	0.006	0.011	0.003	0.002	0.004	0.003
89-02-14	3	-8.642	-9.181	-8.576	0.028	0.021	0.034	0.011	0.009	0.014	0.011
89-02-15	4	-8.610	-9.144	-8.533	0.05	0.058	0.077	0.024	0.024	0.031	0.026
89-02-16	5	-8.569	-9.116	-8.511	0.101	0.086	0.099	0.041	0.035	0.040	0.039
89-02-17	6	-8.515	-9.067	-8.457	0.155	0.135	0.153	0.063	0.055	0.062	0.060
89-02-20	9	-8.37	-8.941	-8.321	0.3	0.261	0.289	0.121	0.106	0.117	0.115
89-02-21	10	-8.335	-8.91	-8.285	0.335	0.292	0.325	0.136	0.119	0.132	0.129
89-02-22	11	-8.297	-8.880	-8.243	0.373	0.342	0.367	0.151	0.139	0.149	0.146
89-02-23	12	-8.246	-8.830	-8.204	0.424	0.372	0.406	0.172	0.151	0.164	0.162
89-02-24	13	-8.241	-8.821	-8.183	0.429	0.381	0.427	0.174	0.155	0.173	0.167
89-02-27	16	-8.135	-8.725	-8.089	0.535	0.477	0.521	0.217	0.194	0.211	0.207

HIGH TEMPERATURE TEST

Maurices Pit, Concrete Sand



HIGH TEMPERATURE TEST

TYPE AND SOURCE OF AGGREGATES : Maurices Pit, Concrete Sand

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Ltd

ALKALI CONTENT OF CEMENT : 0.89%

DATE BATCHED : 89-02-27

STARTING DATE OF TEST : 89-03-01

BATCH QUANTITIES:

CEMENT (g) — 600

FLY ASH (g) - 0

WATER (ml) — 330

SAND (g) —— 1350

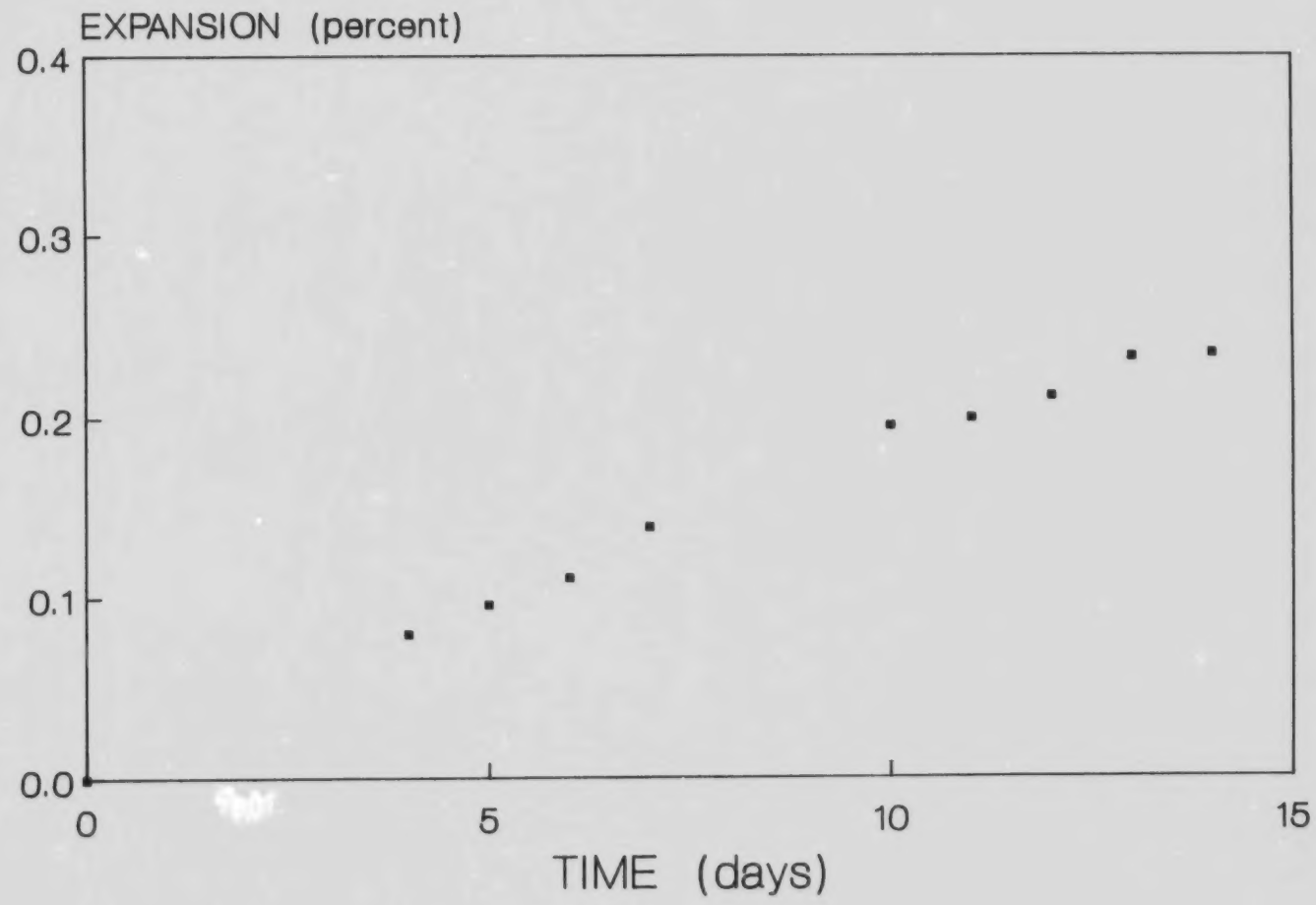
Flow —— 112

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	244.91	246.417	245.575

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
89-03-01	0	-10.695	-9.188	-10.03	0	0	0	0.000	0.000	0.000	0.000
89-03-04	3	-10.671	-9.16	-10.01	0.024	0.028	0.02	0.010	0.011	0.008	0.010
89-03-06	5	-10.631	-9.121	-9.98	0.064	0.067	0.05	0.026	0.027	0.020	0.025
89-03-07	6	-10.594	-9.084	-9.941	0.101	0.104	0.089	0.041	0.042	0.036	0.040
89-03-08	7	-10.555	-9.044	-9.909	0.14	0.144	0.121	0.057	0.059	0.049	0.055
89-03-09	8	-10.528	-9.018	-9.872	0.167	0.17	0.158	0.068	0.069	0.064	0.067
89-03-10	9	-10.51	-8.991	-9.847	0.185	0.197	0.183	0.076	0.080	0.074	0.077
89-03-13	12	-10.426	-8.906	-9.77	0.269	0.282	0.26	0.110	0.115	0.106	0.110
89-03-14	13	-10.41	-8.887	-9.745	0.285	0.301	0.285	0.116	0.123	0.116	0.118
89-03-15	14	-10.399	-8.872	-9.73	0.296	0.316	0.3	0.121	0.129	0.122	0.124

HIGH TEMPERATURE TEST

Rocky Lake Quarry, Crusher Fines



HIGH TEMPERATURE TEST

TYPE AND SOURCE OF AGGREGATES : Rocky Lake Quarry, Crusher Fines

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-08-31

STARTING DATE OF TEST : 88-09-02

BATCH QUANTITIES:

CEMENT (g) — 600

FLY ASH (g) - 0

WATER (ml) — 335

SAND (g) —— 1350

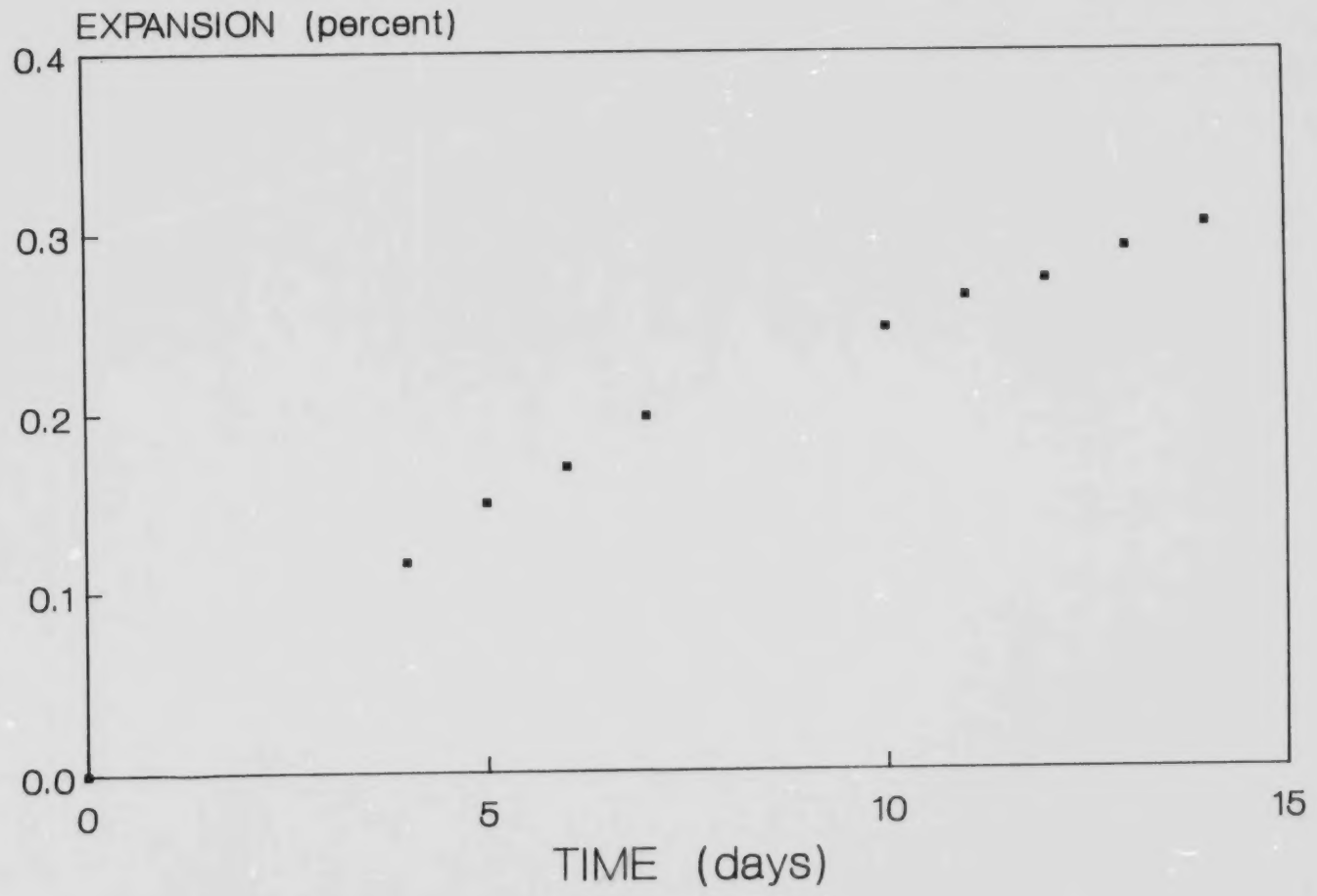
Flow ——— 117

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	254.877	255.434	257.09

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
88-09-02	0	-8.323	-7.766	-6.11	0	0	0	0.000	0.000	0.000	0.000
88-09-06	4	-8.127	-7.544	-5.918	0.196	0.222	0.192	0.077	0.087	0.075	0.079
88-09-07	5	-8.092	-7.503	-5.868	0.231	0.263	0.242	0.091	0.103	0.094	0.096
88-09-08	6	-8.056	-7.46	-5.832	0.267	0.306	0.278	0.105	0.120	0.108	0.111
88-09-09	7	-7.9882	-7.381	-5.762	0.3348	0.385	0.348	0.131	0.151	0.135	0.139
88-09-12	10	-7.832	-7.244	-5.822	0.491	0.522	0.488	0.193	0.204	0.190	0.195
88-09-13	11	-7.829	-7.233	-5.803	0.494	0.533	0.507	0.194	0.209	0.197	0.200
88-09-14	12	-7.801	-7.198	-5.575	0.522	0.568	0.535	0.205	0.222	0.208	0.212
88-09-15	13	-7.746	-7.144	-5.52	0.577	0.622	0.59	0.226	0.244	0.229	0.233
88-09-16	14	-7.738	-7.142	-5.516	0.585	0.624	0.594	0.230	0.244	0.231	0.235

HIGH TEMPERATURE TEST

Conrads Quarry, Crusher Fines



HIGH TEMPERATURE TEST

TYPE AND SOURCE OF AGGREGATES : Conrads Quarry, Crusher Fines

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-08-31

STARTING DATE OF TEST : 88-09-02

BATCH QUANTITIES:

CEMENT (g) — 600

FLY ASH (g) - 0

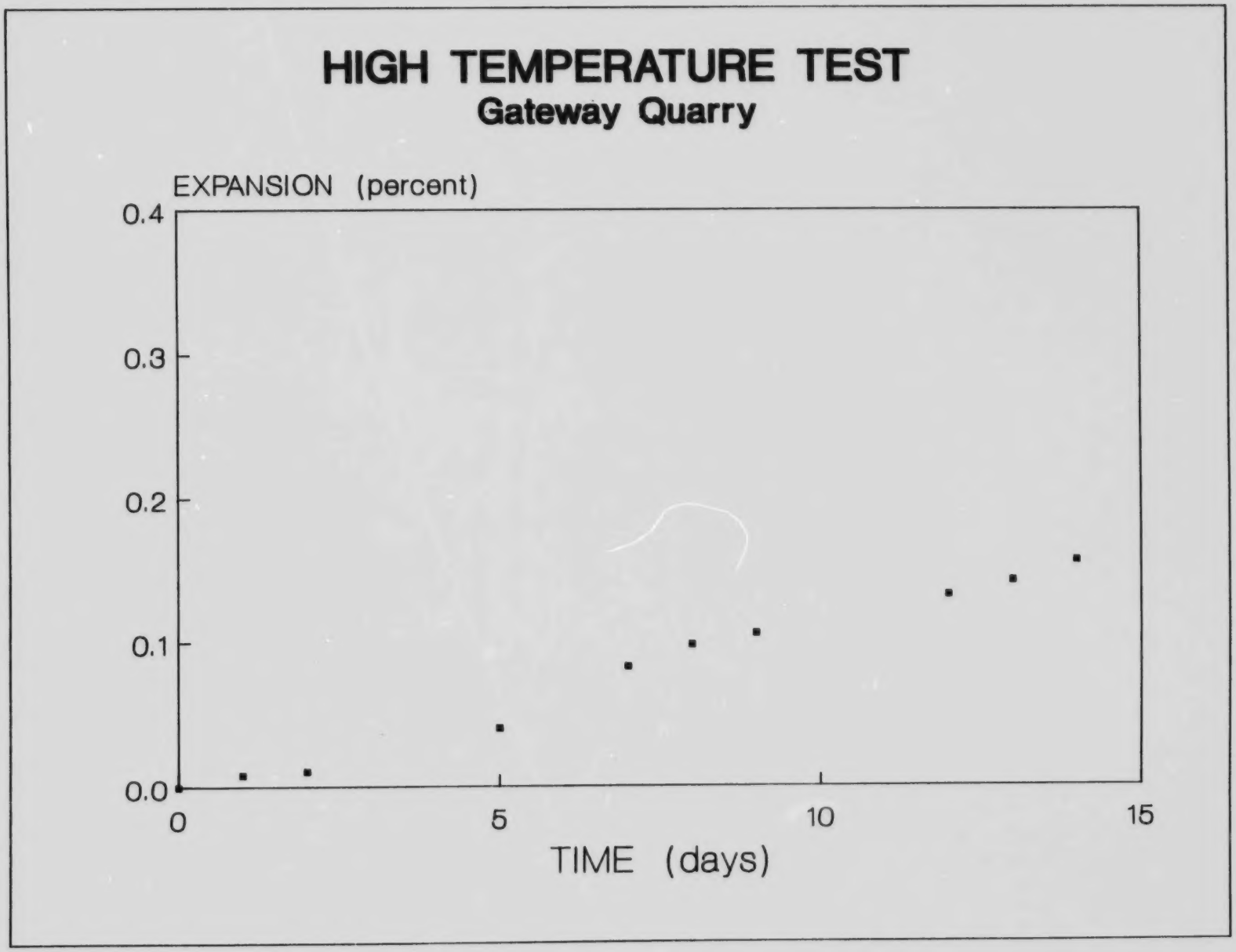
WATER (ml) — 335

SAND (g) —— 1350

Flow —— 127

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	255.773	255.728	255.666

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
88-09-02	0	-7.427	-7.472	-7.534	0	0	0	0.000	0.000	0.000	0.000
88-09-06	4	-7.118	-7.182	-7.241	0.309	0.29	0.293	0.121	0.113	0.115	0.116
88-09-07	5	-7.035	-7.093	-7.16	0.392	0.379	0.374	0.153	0.148	0.146	0.149
88-09-08	6	-6.993	-7.035	-7.106	0.434	0.437	0.428	0.170	0.171	0.167	0.169
88-09-09	7	-6.934	-6.957	-7.024	0.493	0.515	0.51	0.193	0.201	0.199	0.198
88-09-12	10	-6.793	-6.839	-6.905	0.634	0.633	0.629	0.248	0.248	0.246	0.247
88-09-13	11	-6.754	-6.794	-6.856	0.673	0.678	0.678	0.263	0.265	0.265	0.264
88-09-14	12	-6.725	-6.774	-6.834	0.702	0.698	0.7	0.274	0.273	0.274	0.274
88-09-15	13	-6.694	-6.717	-6.79	0.733	0.755	0.744	0.287	0.295	0.291	0.291
88-09-16	14	-6.663	-6.684	-6.755	0.764	0.788	0.779	0.299	0.308	0.305	0.304


HIGH TEMPERATURE TEST
Gateway Quarry
EXPANSION (percent)
0.4
0.3
0.2
0.1
0.0
0
5
10
15
TIME (days)

HIGH TEMPERATURE TEST

TYPE AND SOURCE OF AGGREGATES : Gateway Quarry

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-09-19

STARTING DATE OF TEST : 88-09-21

BATCH QUANTITIES:

CEMENT (g) — 600

FLY ASH (g) - 0

WATER (ml) — 330

SAND (g) —— 1350

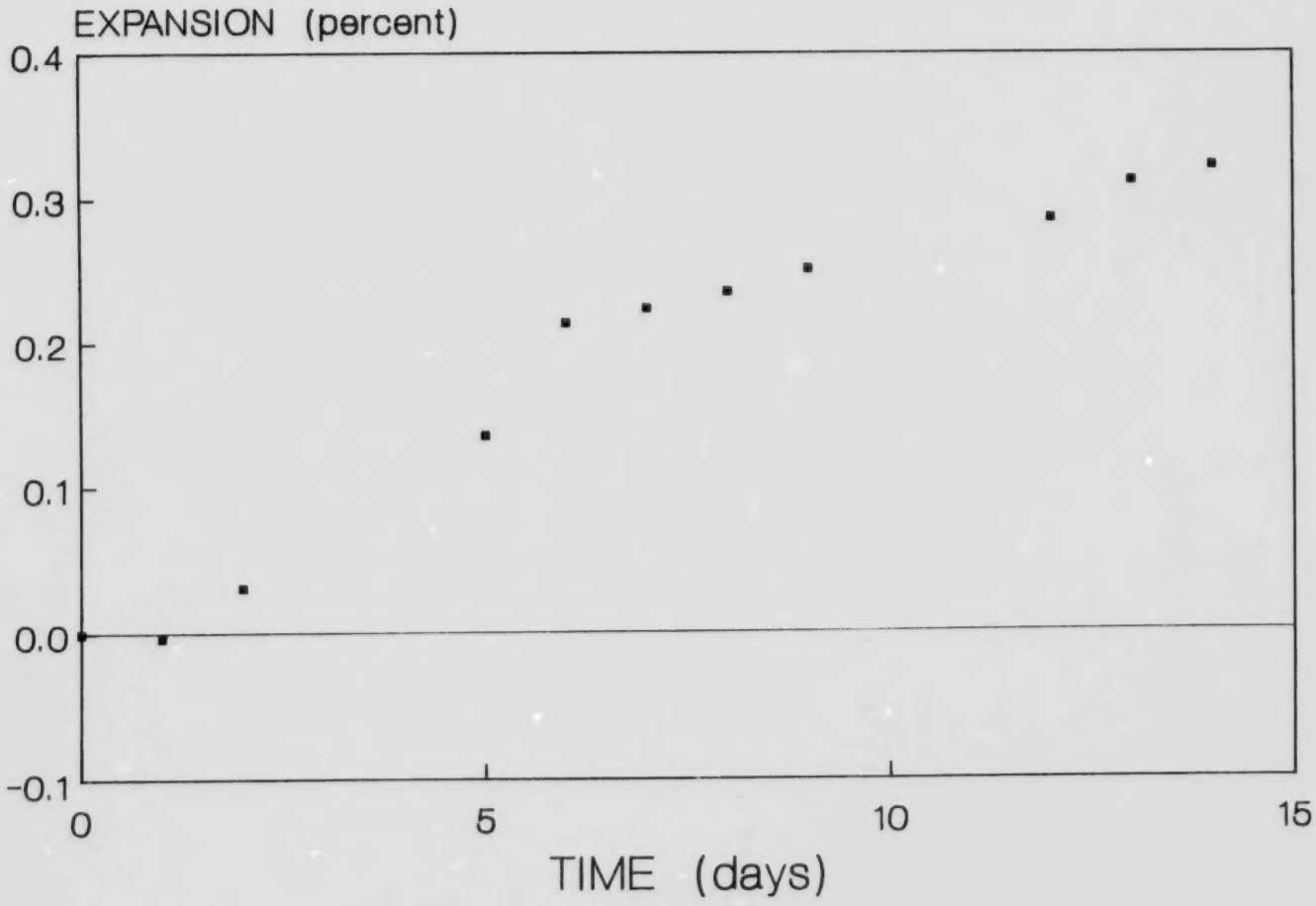
Flow —— 114

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	257.491	256.312	256.491

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
88-09-21	0	-8.817	-7.638	-7.817	0	0	0	0.000	0.000	0.000	0.000
88-09-22	1	-8.799	-7.613	-7.796	0.018	0.025	0.021	0.007	0.010	0.008	0.008
88-09-23	2	-8.793	-7.599	-7.796	0.024	0.039	0.021	0.009	0.015	0.008	0.011
88-09-26	5	-8.717	-7.514	-7.728	0.1	0.124	0.089	0.039	0.048	0.035	0.041
88-09-28	7	-8.605	-7.406	-7.622	0.212	0.232	0.195	0.082	0.091	0.076	0.083
88-09-29	8	-8.563	-7.373	-7.581	0.254	0.265	0.236	0.099	0.103	0.092	0.098
88-09-30	9	-8.542	-7.357	-7.557	0.275	0.281	0.26	0.107	0.110	0.101	0.106
88-10-03	12	-8.477	-7.282	-7.492	0.34	0.356	0.325	0.132	0.139	0.127	0.133
88-10-04	13	-8.444	-7.251	-7.471	0.373	0.377	0.346	0.145	0.147	0.135	0.142
88-10-05	14	-8.416	-7.219	-7.433	0.401	0.419	0.384	0.156	0.163	0.150	0.156

HIGH TEMPERATURE TEST

Steed & Evans Quarry



HIGH TEMPERATURE TEST

TYPE AND SOURCE OF AGGREGATES : Steed & Evans Quarry

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-09-19

STARTING DATE OF TEST : 88-09-21

BATCH QUANTITIES:

CEMENT (g) — 600

FLY ASH (g) - 0

WATER (ml) — 330

SAND (g) — 1350

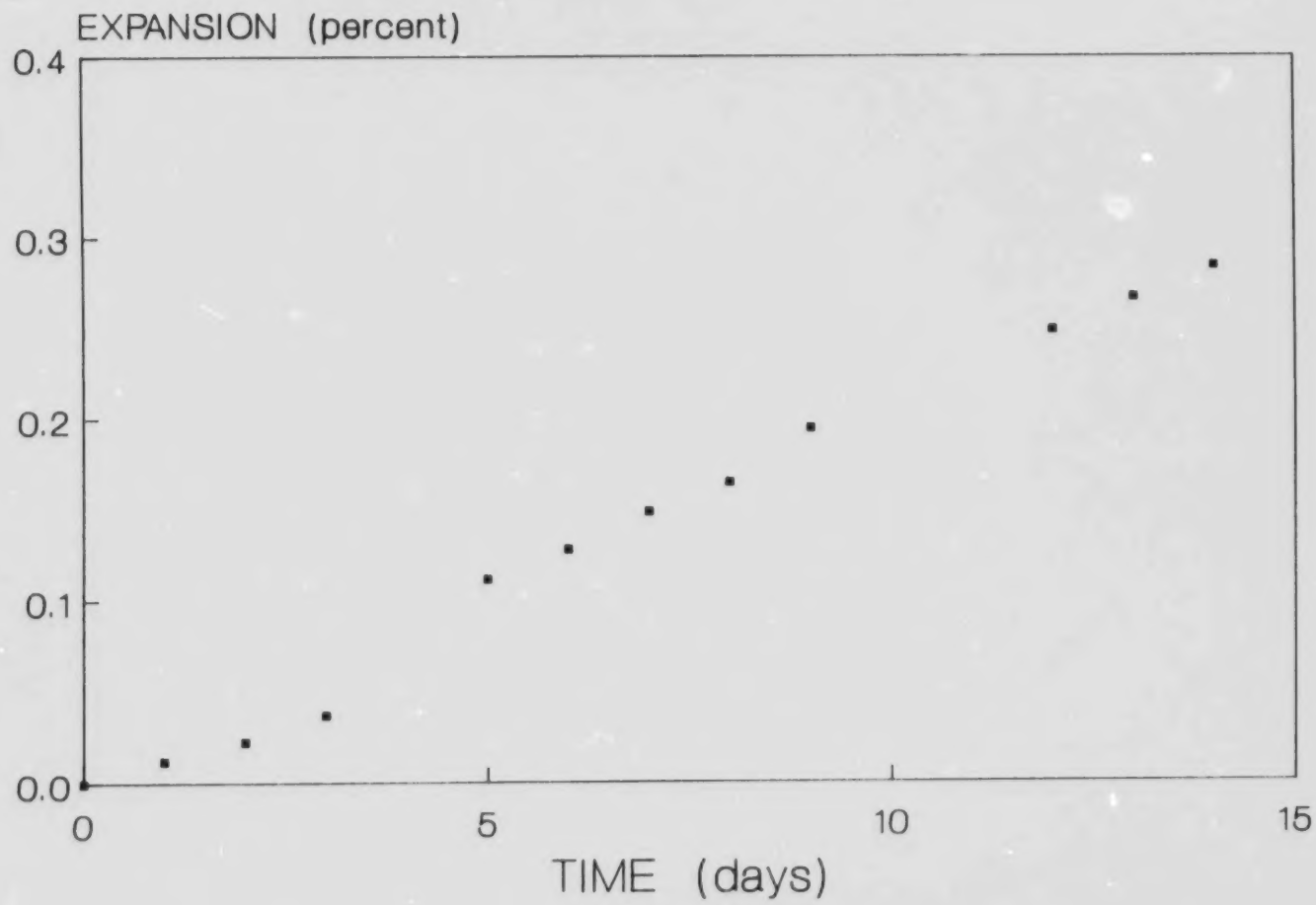
Flow —

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	257.359	256.784	257.002

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
88-09-21	0	-8.685	-8.11	-8.328	0	0	0	0.000	0.000	0.000	0.000
88-09-22	1	-8.685	-8.123	-8.337	0	-0.013	-0.009	0.000	-0.005	-0.004	-0.003
88-09-23	2	-8.592	-8.043	-8.245	0.093	0.067	0.083	0.036	0.026	0.032	0.032
88-09-26	5	-8.316	-7.774	-7.986	0.369	0.336	0.342	0.143	0.131	0.133	0.136
88-09-26	6	-8.122	-7.577	-7.772	0.563	0.533	0.566	0.219	0.208	0.216	0.214
88-09-28	7	-8.101	-7.557	-7.736	0.584	0.553	0.592	0.227	0.215	0.230	0.224
88-09-29	8	-8.069	-7.519	-7.716	0.616	0.591	0.612	0.239	0.230	0.238	0.236
88-09-30	9	-8.042	-7.476	-7.686	0.643	0.634	0.662	0.250	0.247	0.258	0.251
88-10-03	12	-7.948	-7.393	-7.575	0.737	0.717	0.753	0.286	0.279	0.293	0.286
88-10-04	13	-7.88	-7.317	-7.521	0.805	0.793	0.807	0.313	0.309	0.314	0.312
88-10-05	14	-7.854	-7.3	-7.486	0.831	0.81	0.842	0.323	0.315	0.328	0.322

HIGH TEMPERATURE TEST

South Shore Crusher Fines



HIGH TEMPERATURE TEST

TYPE AND SOURCE OF AGGREGATES : South Shore Sand & Gravel, Crusher Fines

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 89-02-06

STARTING DATE OF TEST : 89-02-08

BATCH QUANTITIES:

CEMENT (g) — 600

FLY ASH (g) - 0

WATER (ml) — 330

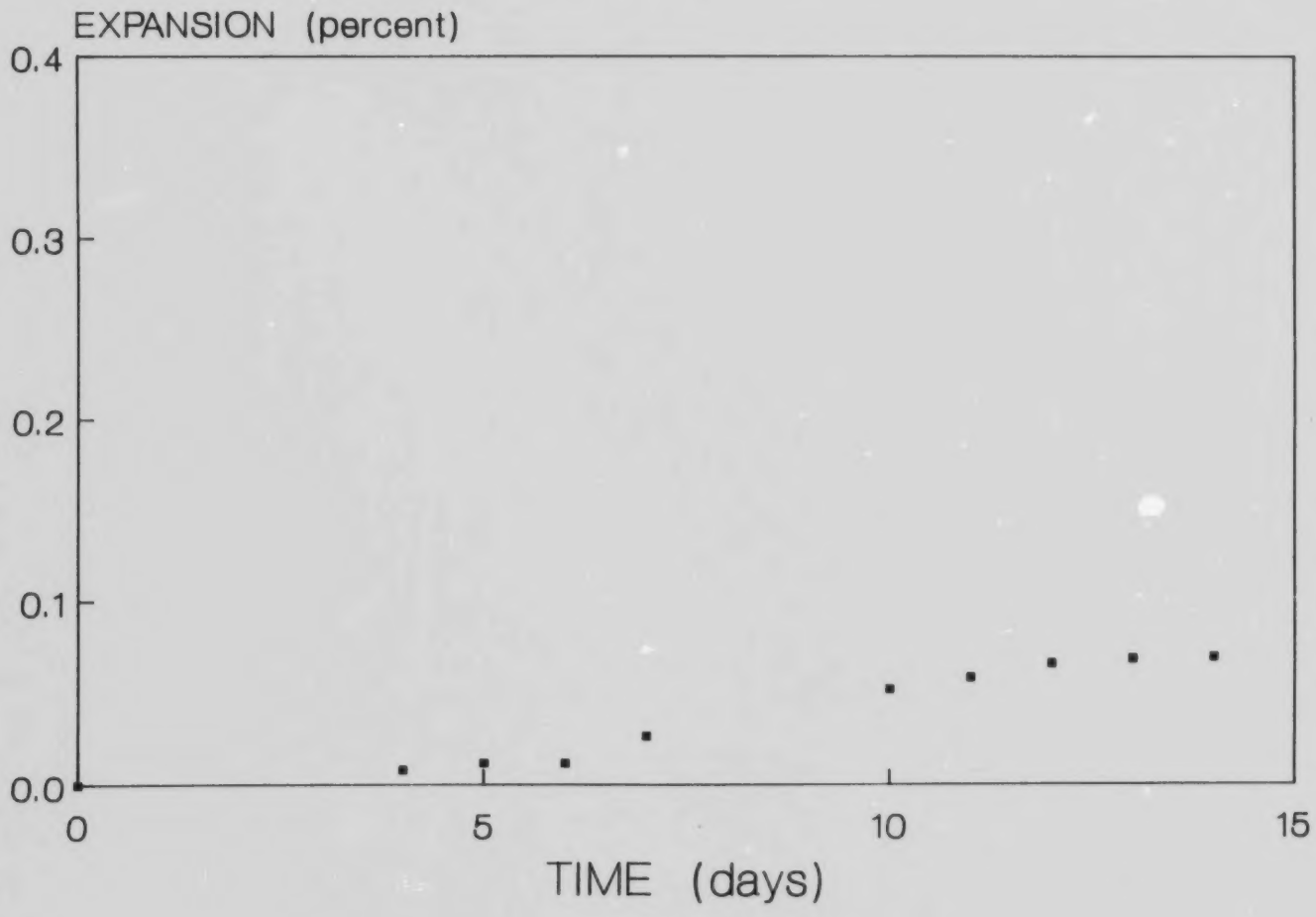
SAND (g) —— 1350

Flow —— 74

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	243.661	246.329	244.124

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
89-02-08	0	-11.945	-9.277	-11.482	0	0	0	0.000	0.000	0.000	0.000
89-02-09	1	-11.904	-9.251	-11.459	0.041	0.026	0.023	0.017	0.011	0.009	0.012
89-02-10	2	-11.891	-9.217	-11.429	0.054	0.06	0.053	0.022	0.024	0.022	0.023
89-02-11	3	-11.845	-9.187	-11.399	0.1	0.09	0.083	0.041	0.037	0.034	0.037
89-02-13	5	-11.67	-9.009	-11.203	0.275	0.268	0.279	0.113	0.109	0.114	0.112
89-02-14	6	-11.63	-8.97	-11.162	0.315	0.307	0.32	0.129	0.125	0.131	0.128
89-02-15	7	-11.575	-8.921	-11.115	0.37	0.356	0.367	0.152	0.145	0.150	0.149
89-02-16	8	-11.531	-8.886	-11.075	0.414	0.391	0.407	0.170	0.159	0.167	0.165
89-02-17	9	-11.47	-8.812	-10.99	0.475	0.465	0.492	0.195	0.189	0.202	0.195
89-02-20	12	-11.33	-8.686	-10.859	0.615	0.591	0.623	0.252	0.240	0.255	0.249
89-02-21	13	-11.288	-8.64	-10.817	0.657	0.637	0.665	0.270	0.259	0.272	0.267
89-02-22	14	-11.24	-8.601	-10.777	0.705	0.676	0.705	0.289	0.274	0.289	0.284

HIGH TEMPERATURE TEST
North Mountain, Proposed Quarry



HIGH TEMPERATURE TEST

TYPE AND SOURCE OF AGGREGATES : North Mountain, Proposed Quarry

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-08-31

STARTING DATE OF TEST : 88-09-02

BATCH QUANTITIES:

CEMENT (g) — 600

FLY ASH (g) - 0

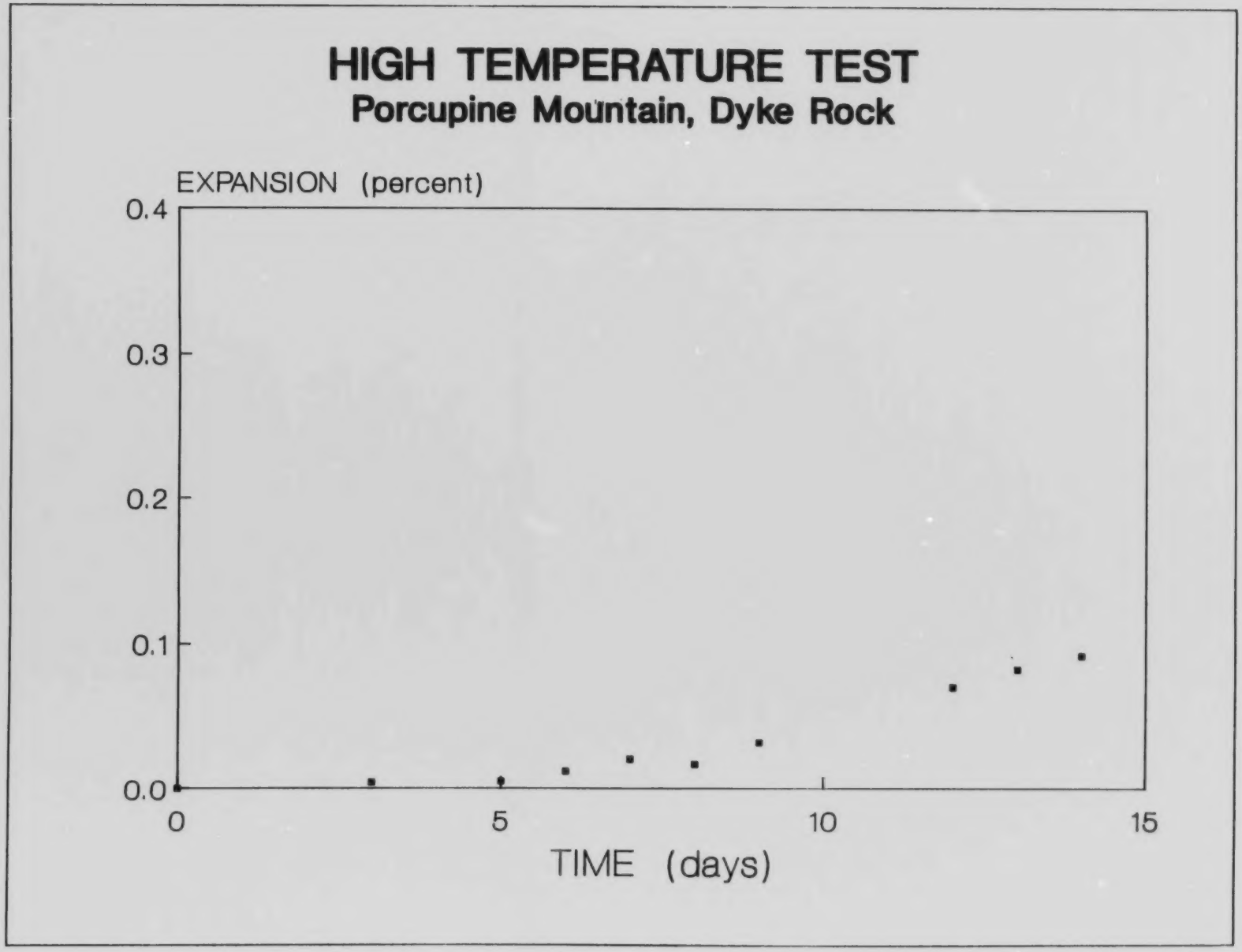
WATER (ml) — 335

SAND (g) —— 1350

Flow ——— 114

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	255.937	255.717	255.728

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
88-09-02	0	-7.263	-7.483	-7.4744	0	0	0	0.000	0.000	0.000	0.000
88-09-05	4	-7.239	-7.465	-7.453	0.024	0.018	0.0214	0.009	0.007	0.008	0.008
88-09-07	5	-7.236	-7.457	-7.435	0.027	0.026	0.0394	0.011	0.010	0.015	0.012
88-09-08	6	-7.242	-7.455	-7.432	0.021	0.028	0.0424	0.008	0.011	0.017	0.012
88-09-09	7	-7.207	-7.407	-7.4	0.056	0.076	0.0744	0.022	0.030	0.029	0.027
88-09-12	10	-7.137	-7.347	-7.336	0.126	0.136	0.1384	0.049	0.053	0.054	0.052
88-09-13	11	-7.114	-7.33	-7.329	0.149	0.153	0.1454	0.058	0.060	0.057	0.058
88-09-14	12	-7.101	-7.315	-7.299	0.162	0.168	0.1754	0.063	0.066	0.069	0.066
88-09-15	13	-7.092	-7.303	-7.3	0.171	0.18	0.1744	0.067	0.070	0.068	0.068
88-09-16	14	-7.088	-7.304	-7.295	0.175	0.179	0.1794	0.068	0.070	0.070	0.070


HIGH TEMPERATURE TEST
Porcupine Mountain, Dyke Rock
EXPANSION (percent)
0.4
0.3
0.2
0.1
0.0
0
5
10
15
TIME (days)

HIGH TEMPERATURE TEST

TYPE AND SOURCE OF AGGREGATES : Porcupine Mountain, Dyke Rock

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Ltd

ALKALI CONTENT OF CEMENT : 0.89%

DATE BATCHED : 89-02-27

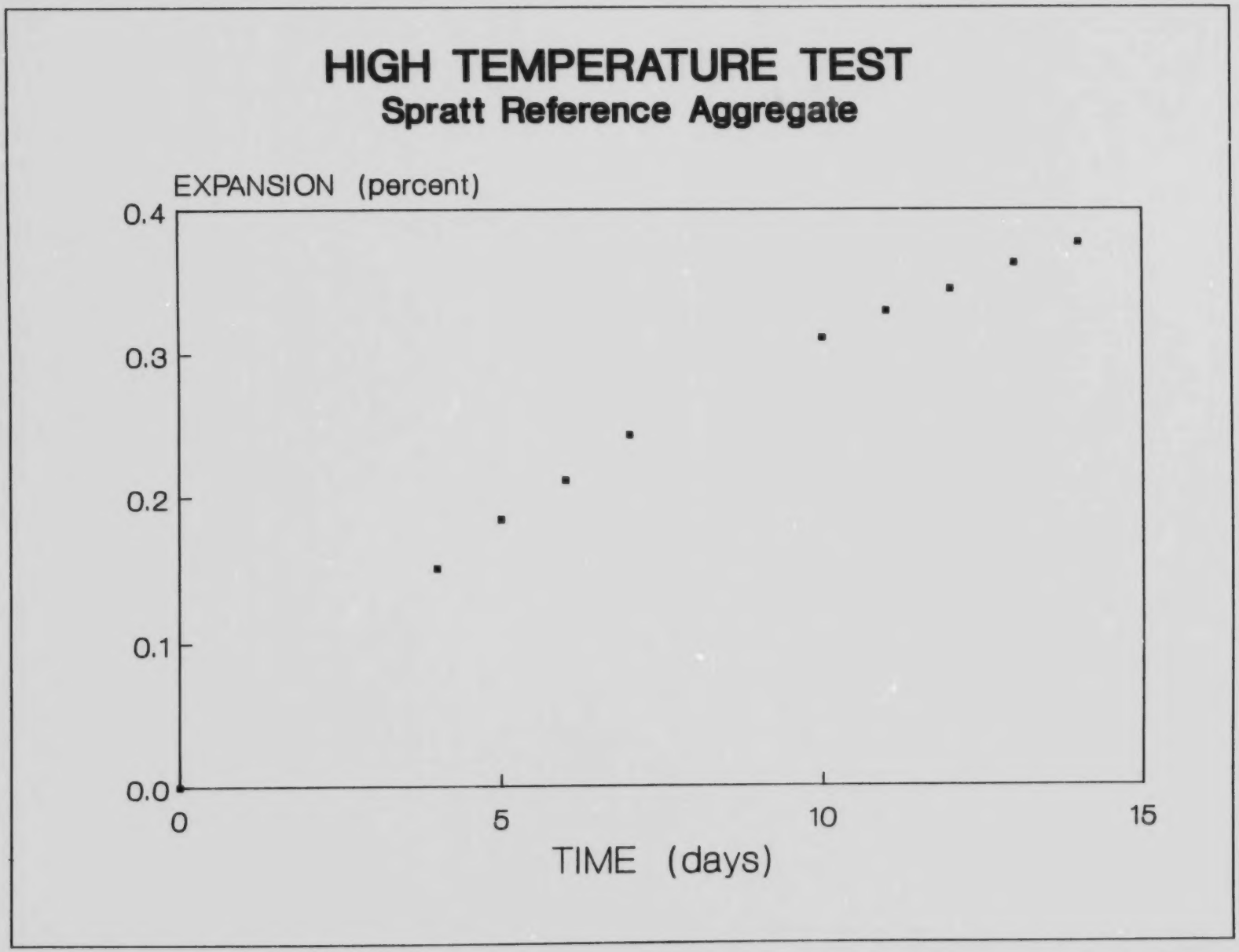
STARTING DATE OF TEST : 89-03-01

BATCH QUANTITIES:

CEMENT (g) — 600
FLY ASH (g) - 0
WATER (ml) — 335
SAND (g) —— 1350
Flow ——

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	245.745	246.153	246.809

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
89-03-01	0	-9.86	-9.442	-8.796	0	0	0	0.000	0.000	0.000	0.000
89-03-04	3	-9.848	-9.43	-8.788	0.012	0.012	0.008	0.005	0.005	0.003	0.004
89-03-06	5	-9.844	-9.431	-8.785	0.016	0.011	0.011	0.007	0.004	0.004	0.005
89-03-07	6	-9.828	-9.411	-8.77	0.032	0.031	0.026	0.013	0.013	0.011	0.012
89-03-08	7	-9.818	-9.393	-8.734	0.042	0.049	0.062	0.017	0.020	0.025	0.021
89-03-09	8	-9.815	-9.403	-8.755	0.045	0.039	0.041	0.018	0.016	0.017	0.017
89-03-10	9	-9.776	-9.362	-8.722	0.084	0.08	0.074	0.034	0.032	0.030	0.032
89-03-13	12	-9.679	-9.269	-8.628	0.181	0.173	0.168	0.074	0.070	0.068	0.071
89-03-14	13	-9.647	-9.237	-8.6	0.213	0.205	0.196	0.087	0.083	0.079	0.083
89-03-15	14	-9.618	-9.215	-8.581	0.242	0.227	0.215	0.098	0.092	0.087	0.093


HIGH TEMPERATURE TEST
Spratt Reference Aggregate
EXPANSION (percent)
0.4
0.3
0.2
0.1
0.0
0
5
10
15
TIME (days)

HIGH TEMPERATURE TEST

TYPE AND SOURCE OF AGGREGATES : Spratt Reference Aggregate

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : August 31, 19888

STARTING DATE OF TEST : September 2, 1999

BATCH QUANTITIES:

CEMENT (g) — 600

FLY ASH (g) - 0

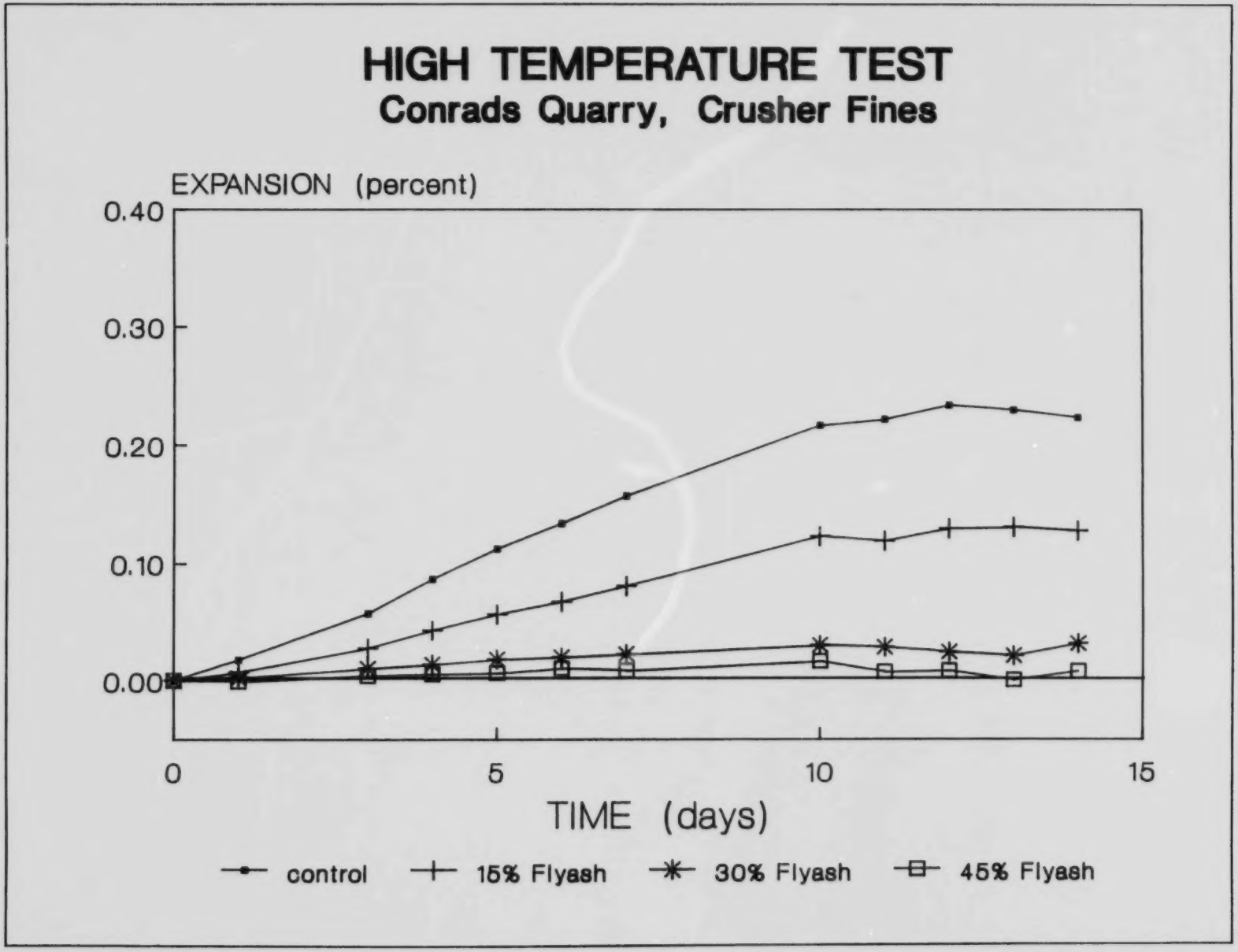
WATER (ml) — 330

SAND (g) — 1380

Flow —— 117

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	255.776	255.137	254.017

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
88-09-02	0	-7.424	-8.063	-9.183	0	0	0	0.000	0.000	0.000	0.000
88-09-06	4	-7.034	-7.665	-8.818	0.39	0.398	0.365	0.152	0.156	0.144	0.151
88-09-07	5	-6.94	-7.575	-8.745	0.484	0.488	0.438	0.189	0.191	0.172	0.184
88-09-08	6	-6.87	-7.509	-8.674	0.554	0.554	0.509	0.217	0.217	0.200	0.211
88-09-09	7	-6.789	-7.436	-8.586	0.635	0.627	0.597	0.248	0.246	0.235	0.243
88-09-12	10	-6.62	-7.249	-8.421	0.804	0.814	0.762	0.314	0.319	0.300	0.311
88-09-13	11	-6.579	-7.1997	-8.368	0.845	0.8633	0.815	0.330	0.338	0.321	0.330
88-09-14	12	-6.536	-7.163	-8.332	0.888	0.9	0.851	0.347	0.353	0.335	0.345
88-09-15	13	-6.496	-7.115	-8.283	0.928	0.948	0.9	0.363	0.372	0.354	0.363
88-09-16	14	-6.468	-7.076	-8.242	0.956	0.987	0.941	0.374	0.387	0.370	0.377


HIGH TEMPERATURE TEST
Conrads Quarry, Crusher Fines
EXPANSION (percent)
0.40
0.30
0.20
0.10
0.00
0
5
10
15
TIME (days)
control
15% Flyash
30% Flyash
45% Flyash

HIGH TEMPERATURE TEST
CONTROL

TYPE AND SOURCE OF AGGREGATES : Conrsde Quarry, Crusher Fines

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-11-30

STARTING DATE OF TEST : 88-12-02

BATCH QUANTITIES:

CEMENT (g) — 600

FLY ASH (g) - 0

WATER (ml) — 330

SAND (g) — 1350

Flow — 101

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	243.084	245.747	245.16

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
88-12-02	0	-12.521	-9.858	-10.445	0	0	0	0.000	0.000	0.000	0.000
88-12-03	1	-12.388	-9.853	-10.455	0.133	0.005	-0.01	0.055	0.002	-0.004	0.018
88-12-05	3	-12.388	-9.72	-10.296	0.133	0.138	0.149	0.055	0.056	0.061	0.057
88-12-06	4	-12.317	-9.647	-10.223	0.204	0.211	0.222	0.084	0.086	0.091	0.087
88-12-07	5	-12.252	-9.585	-10.162	0.269	0.273	0.283	0.111	0.111	0.115	0.112
88-12-08	6	-12.197	-9.529	-10.114	0.324	0.329	0.331	0.133	0.134	0.135	0.134
88-12-09	7	-12.142	-9.467	-10.06	0.379	0.391	0.385	0.156	0.159	0.157	0.157
88-12-12	10	-11.994	-9.33	-9.911	0.527	0.528	0.534	0.217	0.215	0.218	0.216
88-12-13	11	-11.976	-9.323	-9.899	0.545	0.535	0.546	0.224	0.218	0.223	0.222
88-12-14	12	-11.948	-9.291	-9.872	0.573	0.567	0.573	0.236	0.231	0.234	0.233
88-12-15	13	-11.95	-9.299	-9.884	0.561	0.56	0.561	0.231	0.228	0.229	0.229
88-12-16	14	-11.977	-9.318	-9.895	0.544	0.542	0.55	0.224	0.221	0.224	0.223

HIGH TEMPERATURE TEST
15% FLYASH

TYPE AND SOURCE OF AGGREGATES : Conrads Quarry, Crusher Fines

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-11-30

STARTING DATE OF TEST : 88-12-02

BATCH QUANTITIES:

CEMENT (g) — 510

FLY ASH (g) - 90

WATER (ml) — 330

SAND (g) —— 1350

Flow —— 112

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	244.074	244.932	246.807

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
88-12-02	0	-11.531	-10.673	-8.798	0	0	0	0.000	0.000	0.000	0.000
88-12-03	1	-11.508	-10.661	-8.783	0.023	0.012	0.015	0.009	0.005	0.006	0.007
88-12-05	3	-11.455	-10.614	-8.731	0.076	0.059	0.067	0.031	0.024	0.027	0.027
88-12-06	4	-11.421	-10.573	-8.693	0.11	0.1	0.105	0.045	0.041	0.043	0.043
88-12-07	5	-11.388	-10.539	-8.659	0.143	0.134	0.139	0.059	0.055	0.056	0.057
88-12-08	6	-11.363	-10.513	-8.63	0.168	0.16	0.168	0.069	0.065	0.068	0.067
88-12-09	7	-11.324	-10.468	-8.595	0.207	0.185	0.203	0.085	0.076	0.082	0.081
88-12-12	10	-11.219	-10.377	-8.5	0.312	0.296	0.298	0.128	0.121	0.121	0.123
88-12-13	11	-11.221	-10.4	-8.505	0.31	0.273	0.293	0.127	0.111	0.119	0.119
88-12-14	12	-11.197	-10.377	-8.474	0.334	0.296	0.324	0.137	0.121	0.131	0.130
88-12-15	13	-11.202	-10.364	-8.473	0.329	0.309	0.325	0.135	0.126	0.132	0.131
88-12-16	14	-11.199	-10.377	-8.494	0.332	0.296	0.314	0.136	0.121	0.127	0.128

HIGH TEMPERATURE TEST
30% FLYASH

TYPE AND SOURCE OF AGGREGATES : Conrads Quarry, Crusher Fines

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-11-30

STARTING DATE OF TEST : 88-12-02

BATCH QUANTITIES:

CEMENT (g) — 420

FLY ASH (g) - 180

WATER (ml) — 330

SAND (g) —— 1350

Flow —— 122

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	246.52	246.088	246.374

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
88-12-02	0	-10.085	-9.517	-9.231	0	0	0	0.000	0.000	0.000	0.000
88-12-03	1	-10.082	-9.505	-9.23	0.003	0.012	0.001	0.001	0.005	0.000	0.002
88-12-05	3	-10.063	-9.491	-9.204	0.022	0.026	0.027	0.009	0.011	0.011	0.010
88-12-06	4	-10.051	-9.483	-9.199	0.034	0.034	0.032	0.014	0.014	0.013	0.014
88-12-07	5	-10.037	-9.481	-9.183	0.048	0.036	0.048	0.020	0.015	0.019	0.018
88-12-08	6	-10.036	-9.471	-9.18	0.049	0.046	0.051	0.020	0.019	0.021	0.020
88-12-09	7	-10.03	-9.457	-9.18	0.055	0.06	0.051	0.022	0.024	0.021	0.022
88-12-12	10	-10.013	-9.437	-9.161	0.072	0.08	0.07	0.029	0.033	0.028	0.030
88-12-13	11	-10.024	-9.446	-9.152	0.061	0.071	0.079	0.025	0.029	0.032	0.029
88-12-14	12	-10.025	-9.458	-9.17	0.06	0.059	0.061	0.024	0.024	0.025	0.024
88-12-15	13	-10.038	-9.464	-9.174	0.047	0.053	0.057	0.019	0.022	0.023	0.021
88-12-16	14	-9.999	-9.438	-9.16	0.086	0.079	0.071	0.035	0.032	0.029	0.032

HIGH TEMPERATURE TEST
45% FLYASH

TYPE AND SOURCE OF AGGREGATES : Conrads Quarry, Crusher Fines

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-11-30

STARTING DATE OF TEST : 88-12-02

BATCH QUANTITIES:

CEMENT (g) -- 330

FLY ASH (g) - 270

WATER (ml) -- 330

SAND (g) --- 1350

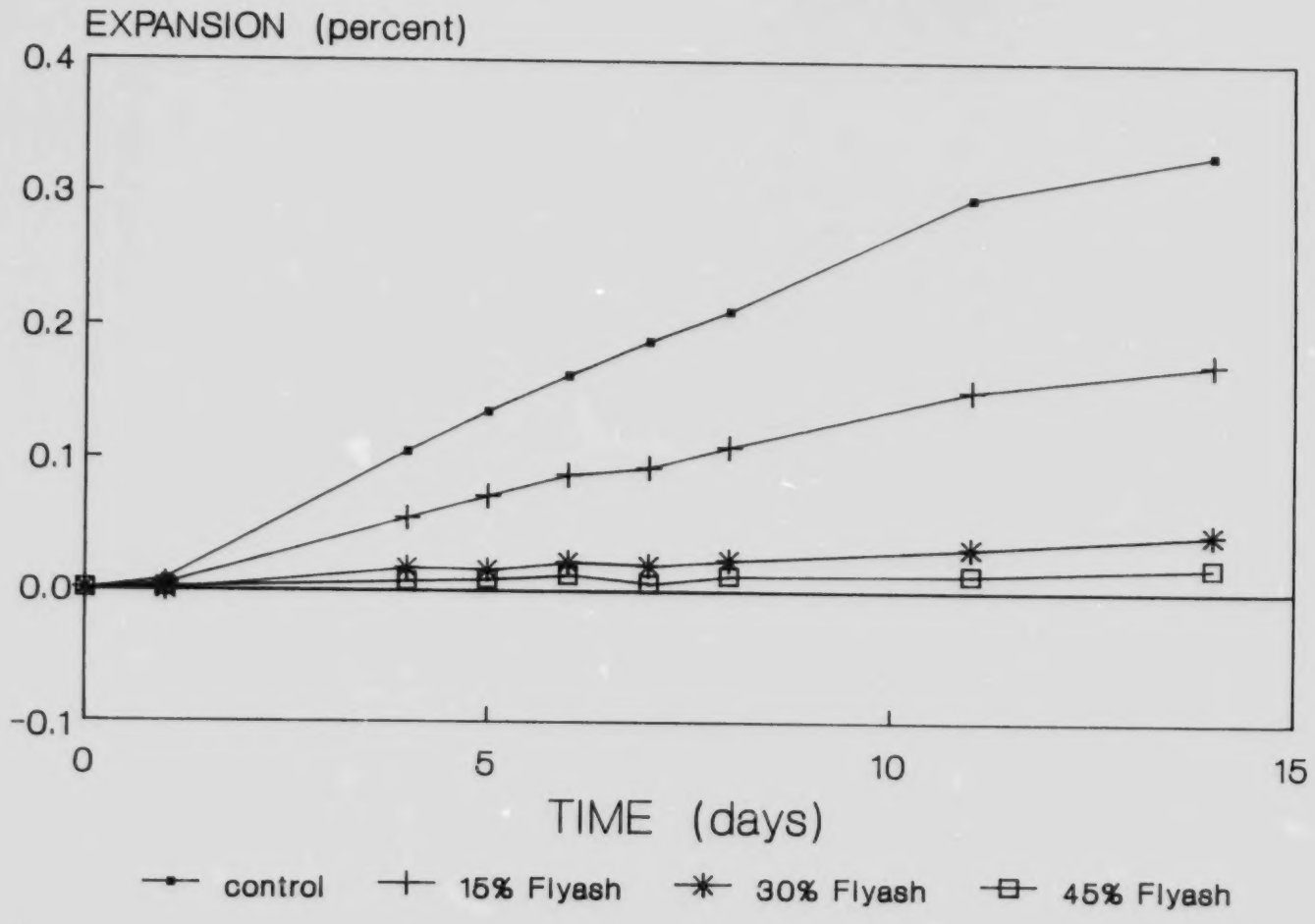
Flow ---- 130

	1	2	3
INITIAL SAMPLE LENGTH (mm) --	243.559	245.98	246.048

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
88-12-02	0	-11.946	-9.625	-9.557	0	0	0	0.000	0.000	0.000	0.000
88-12-03	1	-11.933	-9.631	-9.57	0.013	-0.006	-0.013	0.005	-0.002	-0.005	-0.001
88-12-05	3	-11.922	-9.614	-9.563	0.024	0.011	-0.006	0.010	0.004	-0.002	0.004
88-12-06	4	-11.92	-9.611	-9.558	0.026	0.014	-0.001	0.011	0.006	0.000	0.005
88-12-07	5	-11.928	-9.609	-9.546	0.018	0.016	0.011	0.007	0.007	0.004	0.006
88-12-08	6	-11.907	-9.602	-9.543	0.039	0.023	0.014	0.016	0.009	0.006	0.010
88-12-09	7	-11.912	-9.611	-9.543	0.034	0.014	0.014	0.014	0.006	0.006	0.008
88-12-12	10	-11.885	-9.594	-9.528	0.061	0.031	0.029	0.025	0.013	0.012	0.016
88-12-13	11	-11.918	-9.605	-9.551	0.028	0.02	0.006	0.011	0.008	0.002	0.007
88-12-14	12	-11.901	-9.6	-9.565	0.045	0.025	-0.008	0.018	0.010	-0.003	0.008
88-12-15	13	-11.931	-9.628	-9.565	0.015	-0.003	-0.008	0.006	-0.001	-0.003	0.001
88-12-16	14	-11.911	-9.613	-9.544	0.035	0.012	0.013	0.014	0.005	0.005	0.008

HIGH TEMPERATURE TEST

Rocky Lake Quarry, Crusher Fines



HIGH TEMPERATURE TEST
45% FLYASH

TYPE AND SOURCE OF AGGREGATES : Rocky Lake Quarry, Crusher Fines

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 89-01-24

STARTING DATE OF TEST : 89-01-26

BATCH QUANTITIES:

CEMENT (g) — 330

FLY ASH (g) - 270

WATER (ml) — 330

SAND (g) —— 1350

Flow —— 128

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	244.35	245.693	244.926

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
89-01-26	0	-11.255	-9.912	-10.679	0	0	0	0.000	0.000	0.000	0.000
89-01-27	1	-11.257	-9.907	-10.672	-0.002	0.005	0.007	-0.001	0.002	0.003	0.001
89-01-30	4	-11.24	-9.892	-10.666	0.015	0.02	0.013	0.006	0.008	0.005	0.007
89-01-31	5	-11.238	-9.891	-10.658	0.017	0.021	0.021	0.007	0.009	0.009	0.008
89-02-01	6	-11.223	-9.886	-10.653	0.032	0.026	0.026	0.013	0.011	0.011	0.011
89-02-02	7	-11.251	-9.902	-10.657	0.004	0.01	0.022	0.002	0.004	0.009	0.005
89-02-03	8	-11.236	-9.893	-10.645	0.019	0.029	0.034	0.008	0.012	0.014	0.011
89-02-06	11	-11.235	-9.881	-10.64	0.02	0.031	0.039	0.008	0.013	0.016	0.012
89-02-09	14	-11.218	-9.853	-10.631	0.037	0.049	0.048	0.015	0.020	0.020	0.018

HIGH TEMPERATURE TEST
30% FLYASH

TYPE AND SOURCE OF AGGREGATES : Rocky Lake Quarry, Crusher Fines

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.99 %

DATE BATCHED : 89-01-24

STARTING DATE OF TEST : 89-01-26

BATCH QUANTITIES:

CEMENT (g) — 420

FLY ASH (g) - 180

WATER (ml) — 330

SAND (g) — 1350

Flow — 121

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	245.016	246.368	245.638

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
89-01-26	0	-10.589	-9.237	-9.957	0	0	0	0.000	0.000	0.000	0.000
89-01-27	1	-10.604	-9.236	-9.957	-0.015	0.001	0.01	-0.006	0.000	0.004	-0.001
89-01-30	4	-10.571	-9.169	-9.933	0.018	0.068	0.034	0.007	0.028	0.014	0.016
89-01-31	5	-10.560	-9.201	-9.921	0.029	0.036	0.046	0.012	0.015	0.019	0.015
89-02-01	6	-10.543	-9.189	-9.905	0.046	0.048	0.061	0.019	0.019	0.025	0.021
89-02-02	7	-10.547	-9.197	-9.912	0.042	0.04	0.055	0.017	0.016	0.022	0.019
89-02-03	8	-10.535	-9.19	-9.899	0.054	0.047	0.068	0.022	0.019	0.028	0.023
89-02-06	11	-10.510	-9.164	-9.88	0.079	0.073	0.087	0.032	0.030	0.035	0.032
89-02-09	14	-10.490	-9.136	-9.849	0.099	0.101	0.118	0.040	0.041	0.048	0.043

15% FLYASH

TYPE AND SOURCE OF AGGREGATES : Rocky Lake Quarry, Crusher Fines

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 89-01-24

STARTING DATE OF TEST : 89-01-26

BATCH QUANTITIES:

CEMENT (g) — 510

FLY ASH (g) - 90

WATER (ml) — 330

SAND (g) —— 1350

Flow —— 115

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	245.249	245.411	244.506

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
89-01-26	0	-10.356	-10.194	-11.099	0	0	0	0.000	0.000	0.000	0.000
89-01-27	1	-10.342	-10.188	-11.092	0.014	0.006	0.007	0.006	0.002	0.003	0.004
89-01-30	4	-10.222	-10.057	-10.971	0.134	0.137	0.128	0.055	0.056	0.052	0.054
89-01-31	5	-10.18	-10.017	-10.931	0.176	0.177	0.168	0.072	0.072	0.069	0.071
89-02-01	6	-10.144	-9.98	-10.894	0.212	0.214	0.215	0.086	0.087	0.088	0.087
89-02-02	7	-10.129	-9.962	-10.875	0.227	0.232	0.224	0.093	0.095	0.092	0.093
89-02-03	8	-10.09	-9.925	-10.835	0.266	0.269	0.264	0.108	0.110	0.108	0.109
89-02-06	11	-9.99	-9.82	-10.73	0.366	0.374	0.369	0.149	0.152	0.151	0.151
89-02-09	14	-9.94	-9.77	-10.68	0.416	0.424	0.419	0.170	0.173	0.171	0.171

HIGH TEMPERATURE TEST
CONTROL

TYPE AND SOURCE OF AGGREGATES : Rocky Lake Quarry, Crusher Fines

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 89-01-24

STARTING DATE OF TEST : 89-01-26

BATCH QUANTITIES:

CEMENT (g) — 600

FLY ASH (g) - 0

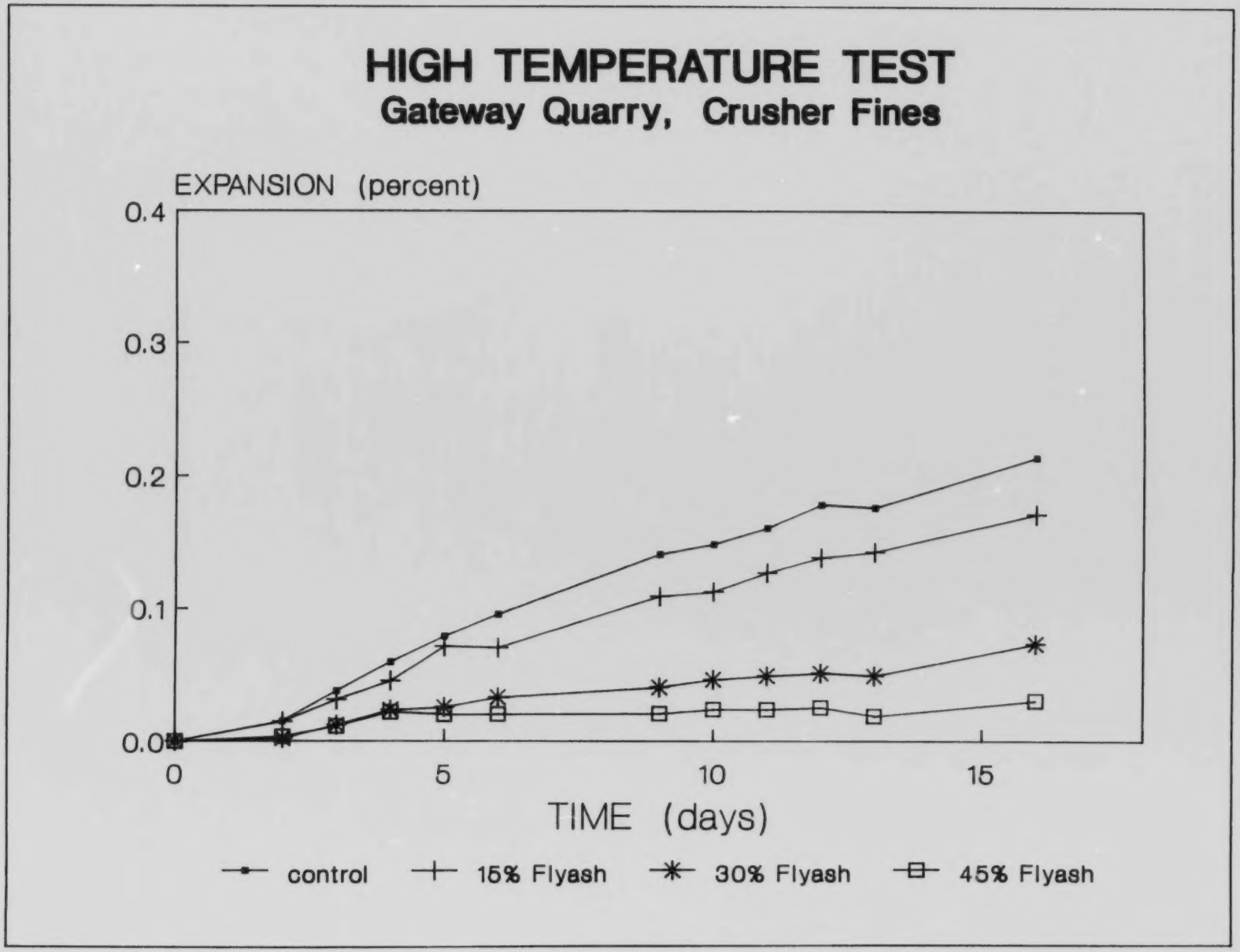
WATER (ml) — 330

SAND (g) —— 1350

Flow —— 100

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	244.424	243.877	244.16

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
89-01-26	0	-11.181	-11.728	-11.445	0	0	0	0.000	0.000	0.000	0.000
89-01-27	1	-11.161	-11.708	-11.431	0.02	0.02	0.014	0.008	0.008	0.006	0.007
89-01-30	4	-10.929	-11.476	-11.181	0.252	0.252	0.264	0.103	0.103	0.108	0.105
89-01-31	5	-10.854	-11.402	-11.109	0.327	0.326	0.336	0.134	0.134	0.138	0.135
89-02-01	6	-10.79	-11.338	-11.039	0.391	0.39	0.406	0.160	0.160	0.166	0.162
89-02-02	7	-10.73	-11.274	-10.973	0.451	0.454	0.472	0.185	0.186	0.193	0.188
89-02-03	8	-10.861	-11.219	-10.93	0.52	0.509	0.515	0.213	0.209	0.211	0.211
89-02-06	11	-10.455	-11.02	-10.711	0.726	0.708	0.734	0.297	0.290	0.301	0.296
89-02-09	14	-10.368	-10.94	-10.631	0.813	0.788	0.814	0.333	0.323	0.333	0.330


HIGH TEMPERATURE TEST
Gateway Quarry, Crusher Fines
EXPANSION (percent)
0.4
0.3
0.2
0.1
0.0
0
5
10
15
TIME (days)
control
15% Flyash
30% Flyash
45% Flyash

HIGH TEMPERATURE TEST
CONTROL

TYPE AND SOURCE OF AGGREGATES : Gateway Quarry, Crusher Fines

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 89-01-19

STARTING DATE OF TEST : 89-01-21

BATCH QUANTITIES:

CEMENT (g) — 600

FLY ASH (g) - 0

WATER (ml) — 330

SAND (g) — 1350

Flow — 94

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	247.135	248.114	248.642

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
89-01-21	0	-8.47	-7.491	-6.963	0	0	0	0.000	0.000	0.000	0.000
89-01-23	2	-8.434	-7.446	-6.932	0.036	0.045	0.031	0.015	0.018	0.012	0.015
89-01-24	3	-8.376	-7.399	-6.868	0.094	0.092	0.095	0.038	0.037	0.038	0.038
89-01-25	4	-8.323	-7.342	-6.815	0.147	0.149	0.148	0.059	0.060	0.060	0.060
89-01-26	5	-8.277	-7.294	-6.765	0.193	0.197	0.198	0.078	0.079	0.080	0.079
89-01-27	6	-8.245	-7.249	-6.718	0.225	0.242	0.245	0.091	0.098	0.099	0.096
89-01-30	9	-8.137	-7.135	-6.601	0.333	0.356	0.362	0.135	0.143	0.146	0.141
89-01-31	10	-8.113	-7.118	-6.585	0.357	0.373	0.378	0.144	0.150	0.152	0.149
89-02-01	11	-8.09	-7.081	-6.553	0.38	0.41	0.41	0.154	0.165	0.165	0.161
89-02-02	12	-8.05	-7.023	-6.51	0.41	0.468	0.453	0.166	0.189	0.182	0.179
89-02-03	13	-8.055	-7.034	-6.52	0.415	0.457	0.443	0.168	0.184	0.178	0.177
89-02-06	16	-7.974	-6.925	-6.431	0.496	0.566	0.532	0.201	0.228	0.214	0.214

HIGH TEMPERATURE TEST
15% FLYASH

TYPE AND SOURCE OF AGGREGATES :	Gateway Quarry, Crusher Fines
TYPE AND SOURCE OF PORTLAND CEMENT :	Type 10, Lafarge Canada Inc.
ALKALI CONTENT OF CEMENT :	0.89 %
DATE BATCHED :	89-11-30
STARTING DATE OF TEST :	89-12-02

BATCH QUANTITIES:

CEMENT (g) —	510
FLY ASH (g) -	90
WATER (ml) —	330
SAND (g) —	1350
Flow ——	110

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	247.745	246.741	245.249

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
89-01-21	0	-7.86	-8.93[illegible]	-10.434	0	0	0	0.000	0.000	0.000	0.000
89-01-23	2	-7.822	-8.9	-10.4	0.038	0.037	0.034	0.015	0.015	0.014	0.015
89-01-24	3	-7.781	-8.864	-10.356	0.079	0.073	0.078	0.032	0.030	0.032	0.031
89-01-25	4	-7.745	-8.829	-10.323	0.115	0.108	0.111	0.046	0.044	0.045	0.045
89-01-26	5	-7.668	-8.787	-10.249	0.192	0.15	0.185	0.077	0.061	0.075	0.071
89-01-27	6	-7.671	-8.766	-10.274	0.189	0.171	0.16	0.076	0.069	0.065	0.070
89-01-30	9	-7.581	-8.672	-10.168	0.279	0.265	0.286	0.113	0.107	0.108	0.109
89-01-31	10	-7.57	-8.666	-10.159	0.29	0.271	0.275	0.117	0.110	0.112	0.113
89-02-01	11	-7.541	-8.626	-10.121	0.319	0.311	0.313	0.129	0.126	0.128	0.127
89-02-02	12	-7.507	-8.6	-10.096	0.353	0.337	0.338	0.142	0.137	0.138	0.13[illegible]
89-02-03	13	-7.497	-8.596	-10.078	0.363	0.341	0.356	0.147	0.138	0.145	0.143
89-02-06	16	-7.43	-8.514	-10.014	0.43	0.423	0.42	0.174	0.171	0.171	0.172

HIGH TEMPERATURE TEST
30% FLYASH

TYPE AND SOURCE OF AGGREGATES : Gateway Quarry, Crusher Fines

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-11-30

STARTING DATE OF TEST : 88-12-02

BATCH QUANTITIES:

CEMENT (g) — 420

FLY ASH (g) - 180

WATER (ml) — 330

SAND (g) —— 1350

Flow —— 122

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	248.985	248.31	247.211

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
89-01-21	0	-8.64	-7.845	-8.394	0	0	0	0.000	0.000	0.000	0.000
89-01-23	2	-8.635	-7.835	-8.393	0.005	0.01	0.001	0.002	0.004	0.000	0.002
89-01-24	3	-8.616	-7.809	-8.364	0.024	0.036	0.03	0.010	0.014	0.012	0.012
89-01-25	4	-8.589	-7.775	-8.34	0.051	0.07	0.054	0.021	0.028	0.022	0.024
89-01-26	5	-8.579	-7.778	-8.332	0.061	0.067	0.062	0.025	0.027	0.025	0.026
89-01-27	6	-8.567	-7.76	-8.307	0.073	0.085	0.087	0.030	0.034	0.035	0.033
89-01-30	9	-8.545	-7.734	-8.298	0.095	0.111	0.096	0.038	0.045	0.039	0.041
89-01-31	10	-8.534	-7.721	-8.279	0.106	0.124	0.115	0.043	0.050	0.047	0.046
89-02-01	11	-8.531	-7.71	-8.272	0.109	0.135	0.122	0.044	0.054	0.049	0.049
89-02-02	12	-8.52	-7.706	-8.271	0.12	0.139	0.123	0.049	0.056	0.050	0.051
89-02-03	13	-8.524	-7.724	-8.265	0.116	0.121	0.129	0.047	0.049	0.052	0.049
89-02-06	16	-8.461	-7.653	-8.217	0.179	0.192	0.177	0.072	0.077	0.072	0.074

HIGH TEMPERATURE TEST
45% FLYASH

TYPE AND SOURCE OF AGGREGATES : Gateway Quarry, Crusher Fines

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-11-30

STARTING DATE OF TEST : 88-12-02

BATCH QUANTITIES:

CEMENT (g) — 330

FLY ASH (g) - 270

WATER (ml) — 330

SAND (g) —— 1350

Flow —— 125

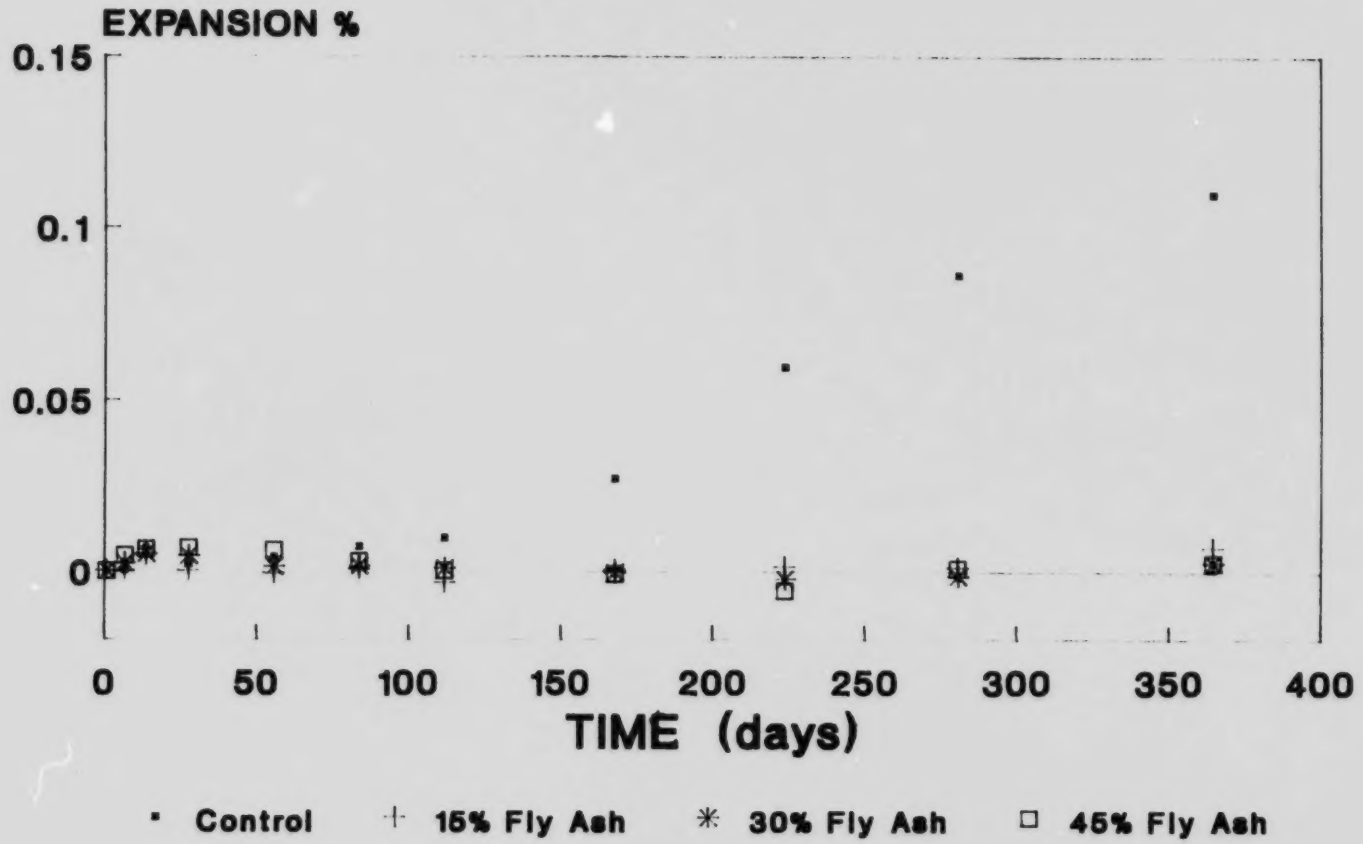
	1	2	3
INITIAL SAMPLE LENGTH (mm) —	248.49	248.045	248.31

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
89-01-21	0	-9.115	-7.591	-7.295	0	0	0	0.000	0.000	0.000	0.000
89-01-23	2	-9.112	-7.581	-7.283	0.003	0.01	0.012	0.001	0.004	0.005	0.003
89-01-24	3	-9.09	-7.56	-7.267	0.025	0.031	0.028	0.010	0.012	0.011	0.011
89-01-25	4	-9.071	-7.538	-7.229	0.044	0.053	0.066	0.018	0.021	0.027	0.022
89-01-26	5	-9.073	-7.537	-7.242	0.042	0.054	0.053	0.017	0.022	0.021	0.020
89-01-27	6	-9.057	-7.538	-7.255	0.058	0.053	0.04	0.024	0.021	0.016	0.020
89-01-30	9	-9.061	-7.539	-7.246	0.054	0.052	0.049	0.022	0.021	0.020	0.021
89-01-31	10	-9.057	-7.53	-7.235	0.058	0.061	0.06	0.024	0.025	0.024	0.024
89-02-01	11	-9.059	-7.529	-7.234	0.056	0.062	0.061	0.023	0.025	0.025	0.024
89-02-02	12	-9.054	-7.523	-7.235	0.061	0.068	0.06	0.025	0.027	0.024	0.025
89-02-03	13	-9.076	-7.549	-7.235	0.039	0.042	0.06	0.016	0.017	0.024	0.019
89-02-06	16	-9.04	-7.514	-7.219	0.075	0.077	0.076	0.030	0.031	0.031	0.031

APPENDIX 6

ACCELERATED CONCRETE PRISM TEST

Conrads Quarry



ACCELERATED CONCRETE PRISM
EXPANSION TEST DATA
(Fly Ash Replacement Mixes)

CONTROL

TYPE AND SOURCE OF AGGREGATES : Conrads Quarry

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-10-20

STARTING DATE OF TEST : 88-10-21

BATCH QUANTITIES:

CEMENT (kg) — - 7.95
FLY ASH (kg) - - 0
WATER (kg) — - 4.98
STONE (kg) — - 27.04
SAND (kg) — - 21.93
NaOH ADDED TO MIX WATER -- -- 35.94 g

PROPERTIES OF MIX:

SLUMP (mm) —— 90
AIR % —— 2.2
28 DAY COMPRESSIVE
STRENGTH (MPa) — 29.2
WATER : CEMENT RATIO — 0.66

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	347.988	348.108	346.827

DATE (d/m/y)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
88-10-21	1	12.208	12.328	11.047	0	0	0	0.000	0.000	0.000	0.000
88-10-27	7	12.207	12.33	11.046	-0.001	0.002	0.001	0.000	0.001	0.000	0.000
88-11-03	14	12.233	12.347	11.072	0.025	0.019	0.025	0.007	0.005	0.007	0.007
88-11-17	28	12.216	12.33	11.057	0.008	0.002	0.01	0.002	0.001	0.003	0.002
88-12-15	56	12.218	12.33	11.078	0.01	0.002	0.031	0.003	0.001	0.009	0.004
89-01-12	84	12.231	12.348	11.078	0.023	0.02	0.031	0.007	0.006	0.009	0.007
89-02-10	112	12.242	12.358	11.084	0.034	0.03	0.037	0.010	0.009	0.011	0.010
89-04-06	168	12.301	12.442	11.122	0.093	0.114	0.075	0.027	0.033	0.022	0.027
89-06-01	224	12.417	12.587	11.2	0.209	0.259	0.153	0.060	0.074	0.044	0.060
89-07-27	281	12.484	12.712	11.286	0.276	0.384	0.239	0.079	0.110	0.069	0.086
89-10-20	365	12.538	12.824	11.386	0.33	0.486	0.319	0.095	0.142	0.092	0.110

ACCELERATED CONCRETE PRISM EXPANSION TEST DATA
(Fly Ash Replacement Mixes)

15% FLYASH

TYPE AND SOURCE OF AGGREGATES : Conrads Quarry

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-10-20

STARTING DATE OF TEST : 88-10-

BATCH QUANTITIES:

CEMENT (kg) -- 6.76
FLY ASH (kg) - 1.19
WATER (kg) --- 4.83
STONE (kg) --- 27.04
SAND (kg) ---- 21.70
NaOH ADDED TO MIX WATER -- 31.41 g

PROPERTIES OF MIX:

SLUMP (mm) ----- 80
AIR % ---------- 2.1
28 DAY COMPRESSIVE STRENGTH (MPa) -- 25.6
WATER : CEMENT RATIO -- 0.61

	1	2	3
INITIAL SAMPLE LENGTH (mm) --	342.315	343.864	347.234

DATE (d/m/y)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
88-10-21	1	6.535	8.084	11.528	0	0	0	0.000	0.000	0.000	0.000
88-10-27	7	6.535	8.083	11.53	0	-0.001	0.002	0.000	0.000	0.001	0.000
88-11-03	14	6.55	8.102	11.543	0.015	0.018	0.015	0.004	0.005	0.004	0.005
88-11-17	28	6.536	8.087	11.525	0.001	0.003	-0.003	0.000	0.001	-0.001	0.000
88-12-15	56	6.529	8.085	11.526	-0.006	0.001	-0.002	-0.002	0.000	-0.001	-0.001
89-01-12	84	6.535	8.085	11.532	0	0.001	0.004	0.000	0.000	0.001	0.000
89-02-10	112	6.519	8.075	11.518	-0.016	-0.009	-0.01	-0.005	-0.003	-0.003	-0.003
89-04-06	168	6.535	8.09	11.525	0	0.006	-0.003	0.000	0.002	-0.001	0.000
89-06-01	224	6.537	8.091	11.532	0.002	0.007	0.004	0.001	0.002	0.001	0.001
89-07-27	281	6.535	8.096	11.527	0	0.012	-0.001	0.000	0.003	0.000	0.001
89-10-20	365	6.556	8.11	11.554	0.021	0.026	0.026	0.006	0.008	0.007	0.007

ACCELERATED CONCRETE PRISM EXPANSION TEST DATA
(Fly Ash Replacement Mixes)

30% FLYASH

TYPE AND SOURCE OF AGGREGATES : Conrads Quarry

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-10-20

STARTING DATE OF TEST : 88-10-21

BATCH QUANTITIES:

CEMENT (kg) -- 5.57
FLY ASH (kg) - 2.39
WATER (kg) --- 4.88
STONE (kg) --- 27.04
SAND (kg) ---- 21.45
NaOH ADDED TO MIX WATER -- 25.88 g

PROPERTIES OF MIX:

SLUMP (mm) ----- 85
AIR % ---------- 1.8
28 DAY COMPRESSIVE STRENGTH (MPa) -- 23.7
WATER : CEMENT RATIO -- 0.61

	1	2	3
INITIAL SAMPLE LENGTH (mm) --	347.992	347.935	350.509

DATE (d/m/y)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
88-10-21	1	12.212	12.155	14.729	0	0	0	0.000	0.000	0.000	0.000
88-10-27	7	12.22	12.153	14.746	0.008	-0.002	0.017	0.002	-0.001	0.005	0.002
88-11-03	14	12.23	12.159	14.758	0.018	0.004	0.029	0.005	0.001	0.008	0.005
88-11-17	28	12.23	12.158	14.753	0.018	0.003	0.024	0.005	0.001	0.007	0.004
88-12-15	56	12.224	12.145	14.74	0.012	-0.01	0.011	0.003	-0.003	0.003	0.001
89-01-12	84	12.224	12.146	14.74	0.012	-0.009	0.011	0.003	-0.003	0.003	0.001
89-02-10	112	12.224	12.145	14.735	0.012	-0.01	0.006	0.003	-0.003	0.002	0.001
89-04-06	169	12.217	12.134	14.74	0.005	-0.021	0.011	0.001	-0.006	0.003	0.000
89-05-01	224	12.209	12.132	14.73	-0.003	-0.023	0.001	-0.001	-0.007	0.000	-0.002
89-07-27	281	12.214	12.132	14.734	0.002	-0.023	0.005	0.001	-0.007	0.001	-0.002
89-10-20	366	12.226	12.151	14.744	0.016	-0.004	0.015	0.005	-0.001	0.004	0.003

ACCELERATED CONCRETE PRISM EXPANSION TEST DATA
(Fly Ash Replacement Mixes)

45% FLYASH

TYPE AND SOURCE OF AGGREGATES : Conrads Quarry

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 88-10-20

STARTING DATE OF TEST : 88-10-21

BATCH QUANTITIES:

CEMENT (kg) — 4.37
FLY ASH (kg) - 3.56
WATER (kg) — 4.56
STONE (kg) — 27.04
SAND (kg) —— 21.20
NaOH ADDED TO MIX WATER -- 20.29 g

PROPERTIES OF MIX:

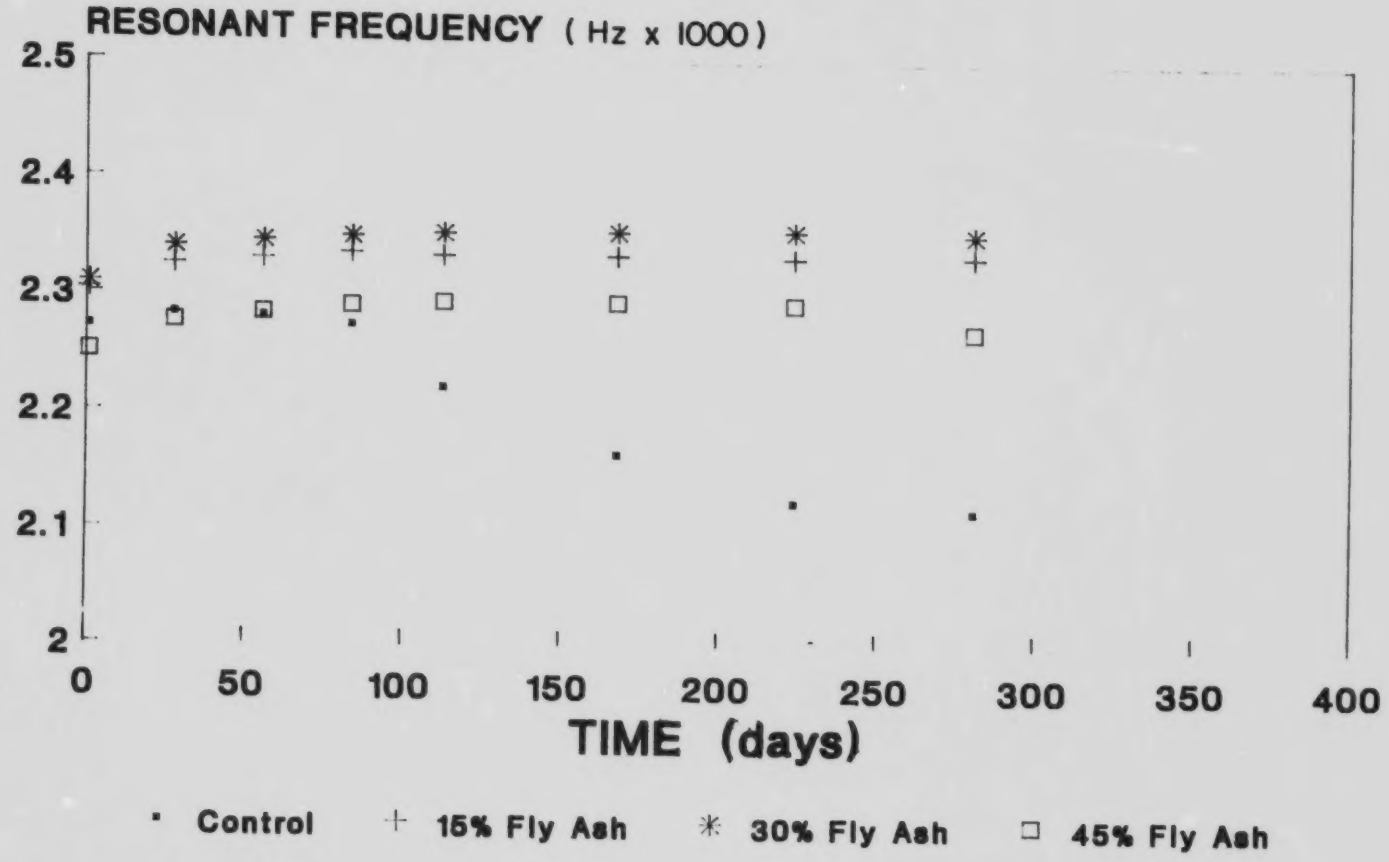
SLUMP (mm) ----- 90
AIR % ---------- 1.9
28 DAY COMPRESSIVE STRENGTH (MPa) -- 18.5
WATER : CEMENT RATIO -- 0.56

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	347.877	348.919	344.393

DATE (d/m/y)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
88-10-21	1	12.09	13.139	8.613	0	0	0	0.000	0.000	0.000	0.000
88-10-27	7	12.108	13.15	8.631	0.018	0.011	0.018	0.005	0.003	0.005	0.005
88-11-03	14	12.11	13.163	8.636	0.02	0.024	0.023	0.006	0.007	0.007	0.006
88-11-17	28	12.113	13.163	8.636	0.023	0.024	0.023	0.007	0.007	0.007	0.007
88-12-15	56	12.117	13.151	8.637	0.027	0.012	0.024	0.008	0.003	0.007	0.006
89-01-12	84	12.104	13.151	8.617	0.014	0.012	0.004	0.004	0.003	0.001	0.003
89-02-10	112	12.082	13.151	8.609	-0.008	0.012	-0.004	-0.002	0.003	-0.001	0.000
89-04-06	168	12.097	13.137	8.599	0.007	-0.002	-0.014	0.002	-0.001	-0.004	-0.001
89-05-01	224	12.061	13.122	8.598	-0.029	-0.017	-0.015	-0.008	-0.005	-0.004	-0.006
89-07-27	281	12.099	13.143	8.609	0.009	0.004	-0.004	0.003	0.001	-0.001	0.001
89-10-20	365	12.108	13.148	8.614	0.018	0.009	0.001	0.005	0.003	0.000	0.003

ACCELERATED CONCRETE PRISM TEST

Conrads Quarry



ACCELERATED CONCRETE PRISM
EXPANSION TEST DATA
(Fly Ash Replacement Mixes)

CONTROL

DATE (yy-mm-dd)	AGE DAYS	RESONANT FREQUENCY 1	2	3	Avg
88-10-21	1	1916	1887	1893	1899
88-11-17	28	2277	2272	2265	2271
88-12-15	56	2288	2282	2278	2283
89-01-12	84	2287	2280	2275	2281
89-02-10	113	2278	2272	2270	2273
89-04-06	168	2219	2206	2237	2221
89-06-01	224	2169	2138	2185	2164
89-07-27	281	2147	2073	2151	2124
89-10-20	365	2142	2080	2127	2116

ACCELERATED CONCRETE PRISM
EXPANSION TEST DATA
(Fly Ash Replacement Mixes)

15% FLYASH

DATE (yy-mm-dd)	AGE DAYS	RESONANT FREQUENCY 1	2	3	Avg
88-10-21	1	1800	1794	1814	1803
88-11-17	28	2302	2300	2306	2303
88-12-15	56	2326	2321	2326	2324
89-01-12	84	2329	2330	2330	2330
89-02-10	112	2334	2333	2337	2335
89-04-06	168	2334	2327	2336	2332
89-06-01	224	2334	2329	2335	2333
89-07-27	281	2331	2330	2333	2331
89-10-20	365	2333	2333	2333	2333

ACCELERATED CONCRETE PRISM
EXPANSION TEST DATA
(Fly Ash Replacement Mixes)

30% FLYASH

DATE (yy-mm-dd)	AGE DAYS	RESONANT FREQUENCY 1	2	3	Avg
88-10-21	1	1710	1740	1708	1719
88-11-17	28	2310	2303	2311	2308
88-12-15	56	2343	2331	2343	2339
89-01-12	84	2348	2337	2348	2344
89-02-10	113	2352	2340	2353	2348
89-04-06	168	2356	2347	2351	2351
89-06-01	224	2358	2348	2354	2353
89-07-27	281	2356	2348	2358	2354
89-10-20	365	2355	2345	2355	2352

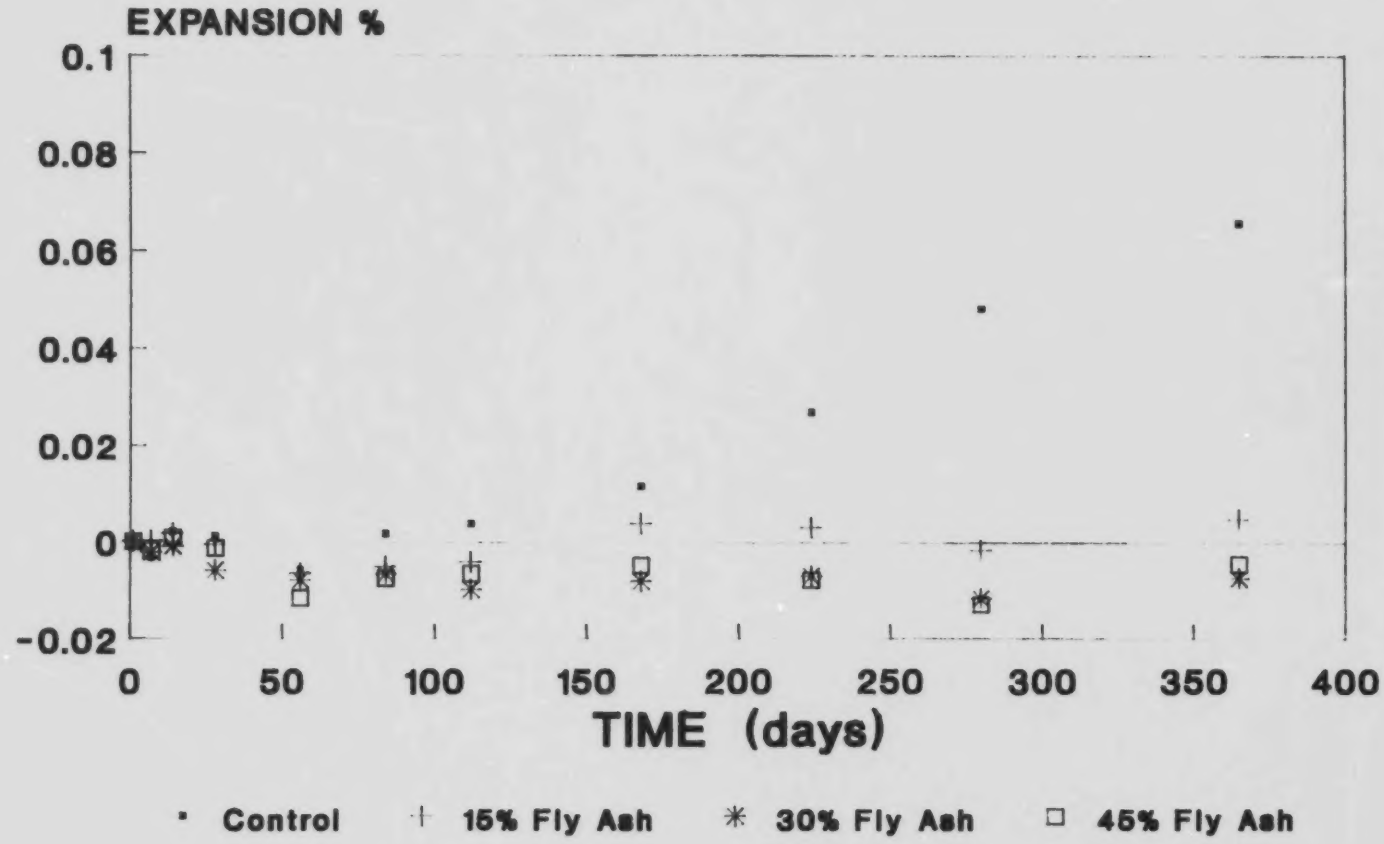
ACCELERATED CONCRETE PRISM
EXPANSION TEST DATA
(Fly Ash Replacement Mixes)

45% FLYASH

DATE (yy-mm-dd)	AGE DAYS	RESONANT FREQUENCY 1	2	3	Avg
88-10-21	1	1380	1527	1474	1460
88-11-17	28	2255	2242	2252	2250
88-12-15	56	2283	2271	2274	2276
89-01-12	84	2288	2277	2286	2284
89-02-10	113	2290	2289	2291	2290
89-04-06	168	2294	2291	2294	2293
89-06-01	224	2297	2286	2296	2293
89-07-27	281	2294	2288	2294	2292
89-10-20	365	2275	2265	2268	2269

ACCELERATED CONCRETE PRISM TEST

Rocky Lake Quarry



ACCELERATED CONCRETE PRISM EXPANSION TEST DATA
(Fly Ash Replacement Mixes)

CONTROL

TYPE AND SOURCE OF AGGREGATES : Rocky Lake Quarry

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 89-02-13

STARTING DATE OF TEST : 89-02-14

BATCH QUANTITIES:

CEMENT (kg) — - 13.95
FLY ASH (kg) - - 0
WATER (kg) — - 9.14
STONE (kg) — - 47.43
SAND (kg) —— - 38.84
NaOH ADDED TO MIX WATER — 64.8g

PROPERTIES OF MIX:

SLUMP (mm) —— 85
AIR % ———— 1.9
28 DAY COMPRESSIVE STRENGTH (MPa) — 29.2
WATER : CEMENT RATIO — 0.65

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	347.881	347.215	344.627

DATE (d/m/y)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSIO %
89-02-14	1	12.101	11.435	8.847	0	0	0	0.000	0.000	0.000	0.00
89-02-21	7	12.093	11.421	8.835	-0.008	-0.014	-0.012	-0.002	-0.004	-0.003	-0.00
89-02-28	14	12.109	11.441	8.854	0.008	0.006	0.007	0.002	0.002	0.002	0.00
89-03-14	28	12.106	11.44	8.848	0.005	0.005	0.001	0.001	0.001	0.000	0.00
89-04-11	56	12.078	11.417	8.826	-0.023	-0.018	-0.021	-0.007	-0.005	-0.006	-0.00
89-05-09	84	12.11	11.44	8.85	0.009	0.005	0.003	0.003	0.001	0.001	0.00
89-06-06	112	12.119	11.445	8.858	0.018	0.01	0.011	0.005	0.003	0.003	0.00
89-08-01	168	12.129	11.472	8.902	0.028	0.037	0.055	0.008	0.011	0.016	0.01
89-09-26	224	12.177	11.542	8.943	0.076	0.107	0.096	0.022	0.031	0.028	0.02
89-11-21	280	12.258	11.632	8.993	0.157	0.197	0.146	0.045	0.057	0.042	0.04
90-02-13	365	12.305	11.744	9.015	0.204	0.309	0.168	0.059	0.089	0.049	0.06

ACCELERATED CONCRETE PRISM EXPANSION TEST DATA
(Fly Ash Replacement Mixes)

15% FLYASH

TYPE AND SOURCE OF AGGREGATES : Rocky Lake Quarry

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 89-02-13

STARTING DATE OF TEST : 89-02-14

BATCH QUANTITIES:

CEMENT (kg) --- 11.66
FLY ASH (kg) - 2.09
WATER (kg) --- 8.34
STONE (kg) --- 47.43
SAND (kg) ---- 38.42
NaOH ADDED TO MIX WATER --- 55.1g

PROPERTIES OF MIX:

SLUMP (mm) ------ 80
AIR % ---------- 1.9
28 DAY COMPRESSIVE
STRENGTH (MPa) -- 25.6
WATER : CEMENT RATIO -- 0.60

	1	2	3
INITIAL SAMPLE LENGTH (mm) ---	345.708	346.873	346.285

DATE (d/m/y)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
89-02-14	1	9.926	11.093	10.505	0	0	0	0.000	0.000	0.000	0.000
89-02-21	7	9.925	11.095	10.507	-0.003	0.002	0.002	-0.001	0.001	0.001	0.000
89-02-28	14	9.932	11.1	10.511	0.004	0.007	0.006	0.001	0.002	0.002	0.002
89-03-14	28	9.925	11.094	10.5	-0.003	0.001	-0.005	-0.001	0.000	-0.001	-0.001
89-04-11	56	9.903	11.074	10.48	-0.025	-0.019	-0.025	-0.007	-0.005	-0.007	-0.007
89-05-09	84	9.905	11.076	10.491	-0.023	-0.017	-0.014	-0.007	-0.005	-0.004	-0.005
89-06-06	112	9.91	11.078	10.494	-0.018	-0.015	-0.011	-0.005	-0.004	-0.003	-0.004
89-08-01	168	9.937	11.109	10.519	0.009	0.016	0.014	0.003	0.005	0.004	0.004
89-09-26	224	9.939	11.105	10.513	0.011	0.012	0.008	0.003	0.003	0.002	0.003
89-11-21	280	9.92	11.088	10.5	-0.008	-0.005	-0.005	-0.002	-0.001	-0.001	-0.002
90-02-13	365	9.94	11.113	10.522	0.012	0.02	0.017	0.003	0.006	0.005	0.005

ACCELERATED CONCRETE PRISM EXPANSION TEST DATA
(Fly Ash Replacement Mixes)

30% FLYASH

TYPE AND SOURCE OF AGGREGATES : Rocky Lake Quarry

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 89-02-13

STARTING DATE OF TEST : 89-02-14

BATCH QUANTITIES:

CEMENT (kg) -- 9.77
FLY ASH (kg) - 4.19
WATER (kg) --- 7.89
STONE (kg) --- 47.43
SAND (kg) ---- 38.0
NaOH ADDED TO MIX WATER -- 45.4g

PROPERTIES OF MIX:

SLUMP (mm) ----- 85
AIR % ---------- 2.2
28 DAY COMPRESSIVE
STRENGTH (MPa) -- 23.7
WATER : CEMENT RATIO -- 0.57

	1	2	3
INITIAL SAMPLE LENGTH (mm) --	346.612	346.069	346.352

DATE (d/m/y)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
89-02-14	1	10.832	10.289	10.572	0	0	0	0.000	0.000	0.000	0.000
89-02-21	7	10.827	10.278	10.564	-0.005	-0.011	-0.008	-0.001	-0.003	-0.002	-0.002
89-02-28	14	10.831	10.282	10.569	-0.001	-0.007	-0.003	0.000	-0.002	-0.001	-0.001
89-03-14	28	10.819	10.264	10.547	-0.013	-0.025	-0.025	-0.004	-0.007	-0.007	-0.006
89-04-11	56	10.816	10.252	10.542	-0.016	-0.037	-0.03	-0.005	-0.011	-0.009	-0.008
89-05-09	84	10.813	10.261	10.549	-0.019	-0.028	-0.023	-0.005	-0.008	-0.007	-0.007
89-06-06	112	10.8	10.251	10.539	-0.032	-0.038	-0.033	-0.009	-0.011	-0.010	-0.010
89-08-01	168	10.807	10.261	10.54	-0.025	-0.028	-0.032	-0.007	-0.008	-0.009	-0.008
89-09-26	224	10.81	10.264	10.545	-0.022	-0.025	-0.027	-0.006	-0.007	-0.008	-0.007
89-11-21	280	10.8	10.248	10.523	-0.032	-0.041	-0.049	-0.009	-0.012	-0.014	-0.012
90-02-13	365	10.81	10.264	10.541	-0.022	-0.025	-0.031	-0.006	-0.007	-0.009	-0.008

ACCELERATED CONCRETE PRISM EXPANSION TEST DATA
(Fly Ash Replacement Mixes)

45% FLYASH

TYPE AND SOURCE OF AGGREGATES : Rocky Lake Quarry

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 89-02-13

STARTING DATE OF TEST : 89-02-14

BATCH QUANTITIES:

CEMENT (kg) — 7.67
FLY ASH (kg) - 6.28
WATER (kg) — 7.34
STONE (kg) — 47.43
SAND (kg) — 37.60
NaOH ADDED TO MIX WATER — 35.6g

PROPERTIES OF MIX:

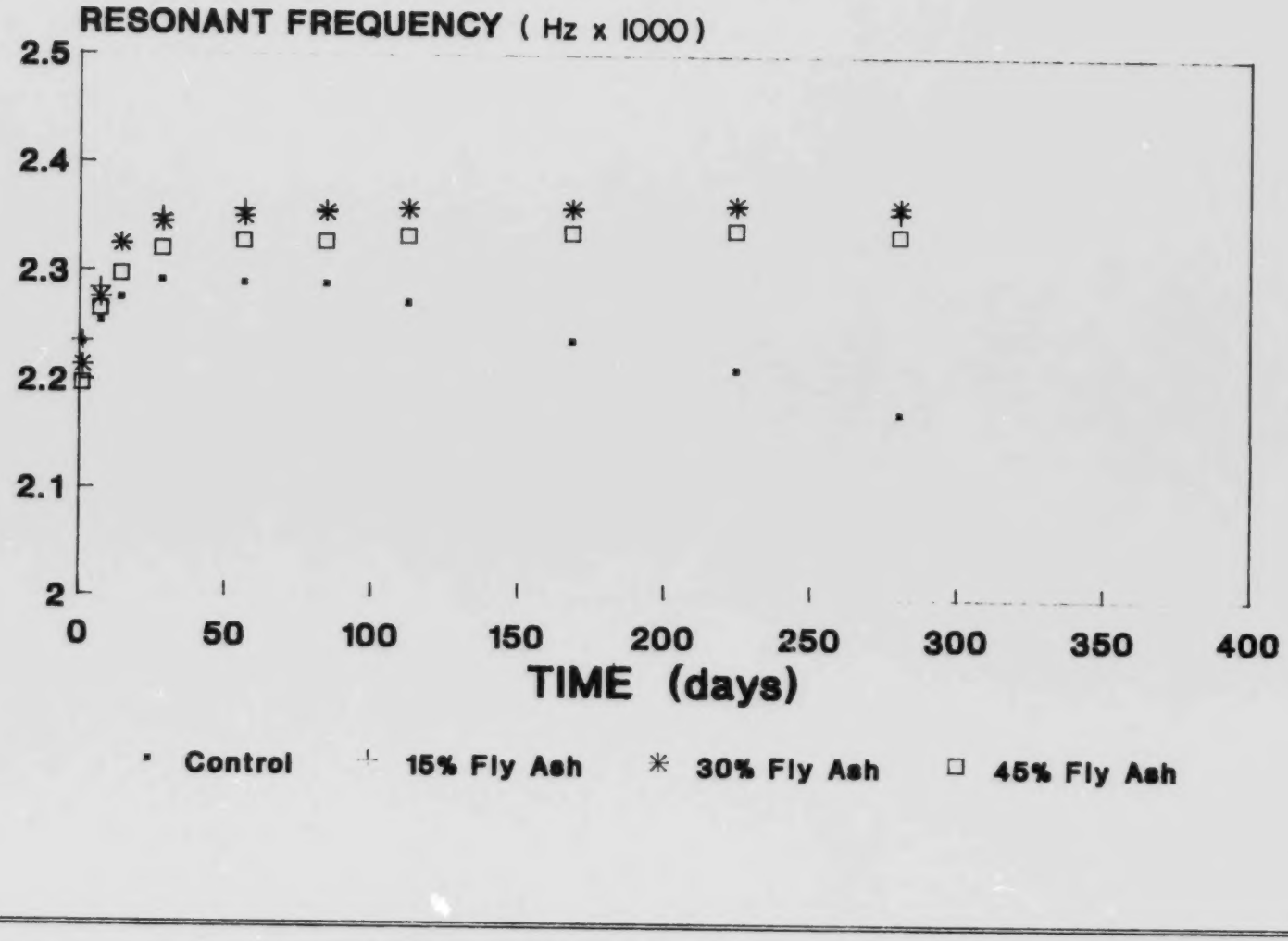
SLUMP (mm) — 85
AIR % — 2.1
28 DAY COMPRESSIVE STRENGTH (MPa) — 18.5
WATER : CEMENT RATIO — 0.53

	1	2	3
INITIAL SAMPLE LENGTH (mm) —	345.53	345.826	345.834

DATE (d/m/y)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
89-02-14	1	9.75	10.046	10.054	0	0	0	0.000	0.000	0.000	0.000
89-02-21	7	9.744	10.037	10.05	-0.006	-0.009	-0.004	-0.002	-0.003	-0.001	-0.002
89-02-28	14	9.75	10.044	10.064	0	-0.002	0.01	0.000	-0.001	0.003	0.001
89-03-14	28	9.738	10.036	10.062	-0.012	-0.01	0.008	-0.003	-0.003	0.002	-0.001
89-04-11	56	9.708	10.001	10.02	-0.042	-0.045	-0.034	-0.012	-0.013	-0.010	-0.012
89-05-09	84	9.723	10.014	10.035	-0.027	-0.032	-0.019	-0.008	-0.009	-0.005	-0.008
89-06-06	112	9.723	10.019	10.04	-0.027	-0.027	-0.014	-0.008	-0.008	-0.004	-0.007
89-08-01	168	9.734	10.023	10.043	-0.016	-0.023	-0.011	-0.005	-0.007	-0.003	-0.005
89-09-26	224	9.719	10.015	10.035	-0.031	-0.031	-0.019	-0.009	-0.009	-0.005	-0.008
89-11-21	280	9.7	9.998	10.018	-0.05	-0.048	-0.036	-0.014	-0.014	-0.010	-0.013
90-02-13	365	9.735	10.029	10.039	-0.015	-0.017	-0.015	-0.004	-0.005	-0.004	-0.005

ACCELERATED CONCRETE PRISM TEST

Rocky Lake Quarry



ACCELERATED CONCRETE PRISM
EXPANSION TEST DATA
(Fly Ash Replacement Mixes)

CONTROL

DATE (yy-mm-dd)	AGE DAYS	RESONANT FREQUENCY 1	2	3	Avg
89-02-14	1	1914	1897	1907	1906
89-02-21	7	2243	2224	2234	2234
89-02-28	14	2263	2243	2255	2254
89-03-14	28	2285	2266	2274	2275
89-04-11	56	2301	2283	2290	2291
89-05-09	84	2298	2282	2287	2289
89-06-06	112	2297	2280	2289	2289
89-08-01	168	2288	2263	2264	2272
89-09-26	224	2257	2214	2239	2237
89-11-21	280	2212	2165	2257	2211
90-02-13	365	2197	2115	2203	2172

ACCELERATED CONCRETE PRISM
EXPANSION TEST DATA
(Fly Ash Replacement Mixes)

15% FLYASH

DATE (yy-mm-dd)	AGE DAYS	RESONANT FREQUENCY 1	2	3	Avg
89-02-14	1	1822	1845	1873	1847
89-02-21	7	2219	2230	2255	2235
89-02-28	14	2269	2280	2300	2283
89-03-14	28	2310	2319	2342	2324
89-04-11	56	2335	2347	2366	2349
89-05-09	84	2342	2353	2373	2356
89-06-06	112	2342	2351	2374	2356
89-08-01	168	2345	2354	2375	2358
89-09-26	224	2343	2356	2374	2358
89-11-21	280	2346	2359	2378	2361
90-02-13	365	2341	2354	2372	2356

ACCELERATED CONCRETE PRISM
EXPANSION TEST DATA
(Fly Ash Replacement Mixes)

30% FLYASH

DATE (yy-mm-dd)	AGE DAYS	RESONANT FREQUENCY 1	2	3	Avg
89-02-14	1	1709	1680	1652	1680
89-02-21	7	2221	2214	2202	2212
89-02-28	14	2284	2280	2259	2274
89-03-14	28	2328	2325	2318	2324
89-04-11	56	2345	2344	2342	2344
89-05-09	84	2348	2355	2345	2349
89-06-06	112	2358	2357	2348	2354
89-08-01	168	2362	2358	2351	2357
89-09-26	224	2362	2359	2353	2358
89-11-21	280	2362	2366	2357	2362
90-02-13	365	2363	2365	2355	2361

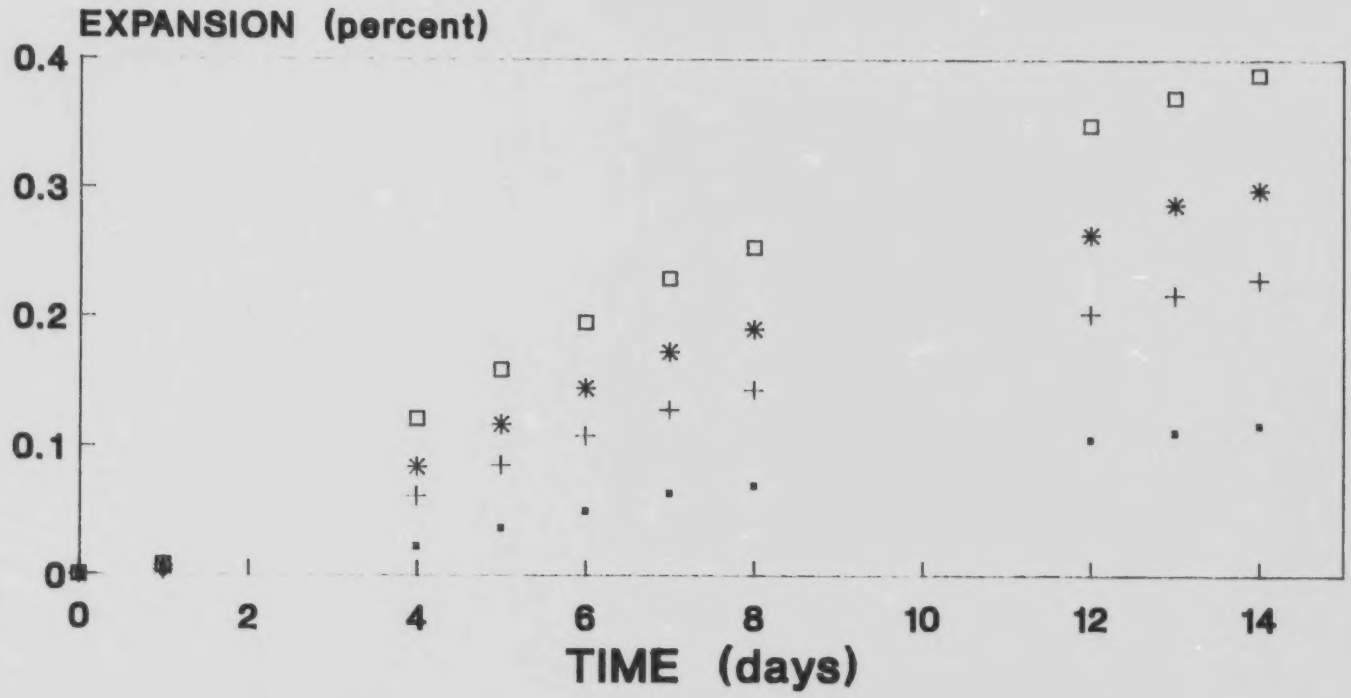
ACCELERATED CONCRETE PRISM
EXPANSION TEST DATA
(Fly Ash Replacement Mixes)

45% FLYASH

DATE (yy-mm-dd)	AGE DAYS	RESONANT FREQUENCY 1	2	3	Avg
89-02-14	1	1335	1411	1418	1388
89-02-21	7	2188	2210	2190	2196
89-02-28	14	2258	2280	2255	2264
89-03-14	28	2290	2312	2288	2297
89-04-11	56	2313	2335	2312	2320
89-05-09	84	2319	2345	2319	2328
89-06-06	112	2318	2345	2319	2327
89-08-01	168	2325	2350	2324	2333
89-09-26	224	2329	2351	2328	2336
89-11-21	280	2331	2358	2329	2339
90-02-13	365	2330	2348	2327	2335

HIGH TEMPERATURE TEST

Rocky Lake Quarry, Crusher Fines



HIGH TEMPERATURE TEST
20% META-GREYWACKE

TYPE AND SOURCE OF AGGREGATES : Rocky Lake Quarry, Crusher Fines

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 90-02-13

STARTING DATE OF TEST : 90-02-15

BATCH QUANTITIES:

CEMENT (g)	440
Crusher Fines (g) -	198
Silica Sand (g)	792
Water (ml)	220
Flow	81

	1	2	3
INITIAL SAMPLE LENGTH (mm) ---	247.653	245.727	244.875

DATE	AGE	GAUGE READING (mm)			LENGTH CHANGE (mm)			PERCENT EXPANSION			AVERAG EXPANSI
(YY-MM-DD)	(days)	1	2	3	1	2	3	1	2	3	%
90-02-15	0	-7.952	-9.876	-10.73	0	0	0	0.000	0.000	0.000	0.(
90-02-16	1	-7.945	-9.874	-10.726	0.007	0.004	0.004	0.003	0.002	0.002	0.(
90-02-19	4	-7.892	-9.818	-10.677	0.06	0.06	0.053	0.024	0.024	0.022	0.(
90-02-20	5	-7.868	-9.776	-10.646	0.094	0.1	0.084	0.038	0.041	0.034	0.(
90-02-21	6	-7.829	-9.75	-10.606	0.123	0.128	0.124	0.050	0.052	0.051	0.(
90-02-22	7	-7.792	-9.712	-10.579	0.16	0.166	0.151	0.065	0.068	0.062	0.(
90-02-23	8	-7.774	-9.697	-10.569	0.178	0.181	0.161	0.072	0.074	0.066	0.(
90-02-27	12	-7.688	-9.606	-10.491	0.264	0.272	0.249	0.107	0.111	0.102	0.1
90-02-28	13	-7.673	-9.595	-10.467	0.279	0.283	0.263	0.113	0.115	0.107	0.1
90-03-01	14	-7.658	-9.58	-10.456	0.294	0.298	0.275	0.119	0.121	0.112	0.1

HIGH TEMPERATURE TEST
40% META-GREYWACKE

TYPE AND SOURCE OF AGGREGATES : Rocky Lake Quarry, Crusher Fines

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 90-02-13

STARTING DATE OF TEST : 90-02-15

BATCH QUANTITIES:

CEMENT (g)	440
Crusher Fines (g) -	396
Silica Sand (g)	594
Water (ml)	220
Flow	80

INITIAL SAMPLE LENGTH (mm) —	1	2	3
	245.998	244.817	246.452

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
90-02-15	0	-9.807	-10.788	-9.153	0	0	0	0.000	0.000	0.000	0.000
90-02-16	1	-9.804	-10.773	-9.145	0.003	0.015	0.008	0.001	0.006	0.003	0.004
90-02-19	4	-9.665	-10.623	-9.005	0.142	0.165	0.148	0.058	0.067	0.060	0.062
90-02-20	5	-9.603	-10.564	-8.951	0.204	0.224	0.202	0.083	0.091	0.082	0.085
90-02-21	6	-9.548	-10.505	-8.897	0.259	0.282	0.256	0.105	0.115	0.104	0.108
90-02-22	7	-9.298	-10.458	-8.849	0.309	0.33	0.304	0.126	0.135	0.123	0.128
90-02-23	8	-9.258	-10.42	-8.814	0.349	0.368	0.339	0.142	0.150	0.138	0.143
90-02-27	12	-9.114	-10.282	-8.677	0.493	0.526	0.476	0.200	0.215	0.193	0.203
90-02-28	13	-9.078	-10.223	-8.645	0.529	0.585	0.508	0.215	0.231	0.206	0.217
90-03-01	14	-9.048	-10.195	-8.615	0.559	0.593	0.538	0.227	0.242	0.218	0.229

HIGH TEMPERATURE TEST

60% META-GREYWACKE

TYPE AND SOURCE OF AGGREGATES : Rocky Lake Quarry, Crusher Fines

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 90-02-13

STARTING DATE OF TEST : 90-02-15

BATCH QUANTITIES:

CEMENT (g)	440
Crusher Fines (g) -	594
Silica Sand (g)	396
Water (ml)	220
Flow	73

	1	2	3
INITIAL SAMPLE LENGTH (mm) --	243.378	245.672	244.42

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSION %
90-02-15	0	-12.227	-9.933	-11.185	0	0	0	0.000	0.000	0.000	0.000
90-02-16	1	-12.207	-9.918	-11.169	0.02	0.015	0.016	0.008	0.006	0.007	0.007
90-02-19	4	-12.008	-9.737	-10.981	0.219	0.196	0.204	0.090	0.080	0.083	0.084
90-02-20	5	-11.933	-9.647	-10.906	0.294	0.286	0.279	0.121	0.116	0.114	0.117
90-02-21	6	-11.865	-9.58	-10.838	0.362	0.353	0.347	0.149	0.144	0.142	0.145
90-02-22	7	-11.786	-9.518	-10.773	0.441	0.415	0.412	0.181	0.169	0.169	0.173
90-02-23	8	-11.75	-9.473	-10.724	0.477	0.46	0.461	0.196	0.187	0.189	0.191
90-02-27	12	-11.583	-9.271	-10.584	0.674	0.662	0.601	0.277	0.269	0.246	0.264
90-02-28	13	-11.511	-9.224	-10.5	0.716	0.709	0.685	0.294	0.289	0.280	0.288
90-03-01	14	-11.482	-9.201	-10.47	0.745	0.732	0.715	0.306	0.298	0.293	0.299

HIGH TEMPERATURE TEST
100% META-GREYWACKE

TYPE AND SOURCE OF AGGREGATES : Rocky Lake Quarry, Crusher Fines

TYPE AND SOURCE OF PORTLAND CEMENT : Type 10, Lafarge Canada Inc.

ALKALI CONTENT OF CEMENT : 0.89 %

DATE BATCHED : 90-02-13

STARTING DATE OF TEST : 90-02-15

BATCH QUANTITIES:

CEMENT (g)	440
Crusher Fines (g) -	990
Silica Sand (g)	0
Water (ml)	220
Flow	63

	1	2	3
INITIAL SAMPLE LENGTH (mm) ---	243.651	243.946	245.587

DATE (YY-MM-DD)	AGE (days)	GAUGE READING (mm) 1	2	3	LENGTH CHANGE (mm) 1	2	3	PERCENT EXPANSION 1	2	3	AVERAGE EXPANSIO %
90-02-15	0	-11.754	-11.659	-10.008	0	0	0	0.000	0.000	0.000	0.0
90-02-16	1	-11.733	-11.639	-9.992	0.021	0.02	0.016	0.009	0.008	0.007	0.0
90-02-19	4	-11.448	-11.36	-9.724	0.306	0.299	0.284	0.125	0.123	0.116	0.1
90-02-20	5	-11.36	-11.267	-9.629	0.394	0.392	0.379	0.162	0.161	0.154	0.1
90-02-21	6	-11.265	-11.182	-9.541	0.489	0.477	0.467	0.201	0.196	0.190	0.1
90-02-22	7	-11.183	-11.089	-9.485	0.571	0.57	0.543	0.234	0.234	0.221	0.2
90-02-23	8	-11.123	-11.03	-9.406	0.631	0.629	0.602	0.259	0.258	0.245	0.2
90-02-27	12	-10.867	-10.796	-9.179	0.867	0.863	0.829	0.356	0.354	0.338	0.3
90-02-28	13	-10.83	-10.748	-9.126	0.924	0.911	0.882	0.379	0.373	0.359	0.3
90-03-01	14	-10.78	-10.707	-9.085	0.974	0.952	0.923	0.399	0.390	0.376	0.3

APPENDIX 7

APPENDIX 8

APPENDIX 9

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PETROGRAPHIC EXAMINATION OF SIX CONCRETE PRISMS AND THREE MORTAR BARS

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REPORT NUMBER: M/90/07

JOB NUMBER: 08200113/1 & 2

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DATE: March 6, 1990

LL:cem

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1.0 INTRODUCTION

A sample (slab) of a concrete prism containing aggregate from Conrads quarry was received at RPC on 24 August 1989 for a petrographic examination. A summary report on this sample was submitted to Jacques Whitford and Associates on 07 September 1989. Eight more samples (five concrete prisms and three mortar bars) were submitted to RPC on 24 November 1989 for petrographic examination.

The following is the list of the samples examined and characterized, petrographically, in this report.

Concrete Prisms	Mortar Bars
1. Chester	1. Barneys
2. Conrads	2. Meadows
3. Gateway	3. Yarmouth
4. Rocky Lake	
5. Steed and Evans	
6. Yarmouth	

The purpose of the concrete prisms examination was to identify and, if present, characterize both alkali reactive rock types and reaction products. The examined prisms contained 1.25% combined alkalies (sodium and potassium) and they were stored at 38 deg. C. and 100% RH in order to induce expansion due to alkali-aggregate reaction.
The mortar bars were investigated in order to identify alkali aggregate reaction products and, if these products were found, to identify reactive rock types. Mortar bars were stored in NaOH solution at 80deg. C. for 14 days to accelerate AAR reaction.

Polished thin sections and fracture sections prepared from all nine samples were investigated with the use of optical micro and macroscopes and a microprobe (Electron Probe Micro Analyser).

2.0 SUMMARY AND CONCLUSIONS

Symptoms of alkali silica reactivity were observed in all the mortar bars and in five concrete prisms; Chester, Conrads, Rocky Lake, Steed and Evans and Yarmouth. Sample Gateway appeared to be free of reaction products.

The alkali reaction products include alkali silica gels and crystalline alkali silicates. Alkali silica gels occur predominantly inside reaction rims of reactive aggregate particles. Crystalline alkali silicates occupy fractures dissecting both aggregate particles and cement paste.

A positive correlation was observed between the expansion rate of the prisms and the abundance of alkali silica gels within reaction rims, hence, the number of reactive particles. Correlations between the overall content of alkali silica gels or intensity of microfracturing of the prisms and expansion of the prisms were not recorded.

Concrete prisms containing more than 70% reactive particles in the coarse fraction; Chester, Conrads, Rocky Lake, Steed and Evans; expanded above the 0.04% limit assumed for non-reactive rocks after 365 days of test duration.

Meta-argillites, meta-greywackes, very fine grained quartzites and meta-tuffs were identified as reactive rock types in both the mortar bars and concrete prisms.

The following was concluded:

(i) The laboratory conditions induced expansion of the prisms due to alkali aggregate reaction.

(ii) The presence of abundant crystalline alkali silicates in expanding prisms indicated that field conditions were not fully simulated in the laboratory.

3.0 OVERALL CHARACTERISTICS; ALL SAMPLES

Meta-argillites, meta-greywackes, very fine grained meta-quartzite and rhyolitic(?) meta-tuffs appear to be the alkali reactive rock types in both the mortar bars and concrete prisms.

Quartz, feldspar, granitoid rocks, rhyolite, gabbroic rocks, basalts, micas (muscovite and biotite), high grade metamorphic schists (with andalusite) and completely recrystallized argillites and greywackes are non-reactive aggregate components in the mortar bars and concrete prisms.

The particles of reactive rock types developed thin reaction rims, between 0.1mm and 0.5mm thick. Reaction rims in light colored rocks are very distinct, while the rims in dark (almost black) meta-sediments are almost invisible if examined without the aid of an microscope. See also photomicrographs included in the description of individual concrete specimens (Chapter 4, this report).

Regardless of the origin and petrographic classification, all reactive rock types contain (highly) variable proportions of fine, less than 0.3mm, quartz, chlorite and/or sericite. The metamorphic recrystallization degree of the reactive rock types ranges from low to moderate as shown in Figs 1 - 4. Metamorphic recrystallization of the non-reactive rock types (Fig. 5) is high. Note, that magmatic rocks (such as granites, basalts) with suture grain boundaries are non-reactive irregardless of their composition.

Table 1 reports percent reactive aggregate particles in individual concrete prisms (it was determined for coarse fraction only). Approximately 150 particles were identified in each prism as either reactive or non-reactive using their petrographic characteristics in order to generate numbers in Table 1.

TABLE 1

PERCENT REACTIVE PARTICLES IN CONCRETE PRISMS

	SAMPLE	% REACTIVE	REACTIVE ROCK TYPES
1.	Conrads	100	meta-(argillite, greywacke)
2.	Rocky Lake	98	meta-(argillite, greywacke)
3.	Steed @ Evans	100	meta-(argillite, greywacke)
4.	Chester	92	meta-(argillite, greywacke)
5.	Gateway	<1 ?	----------
6.	Yarmouth	70	meta-(argillite, greywacke, quartzite)

1-3: Expansion up to 0.12% after 365 days

4-6: Expansion below 0.02% after 365 days

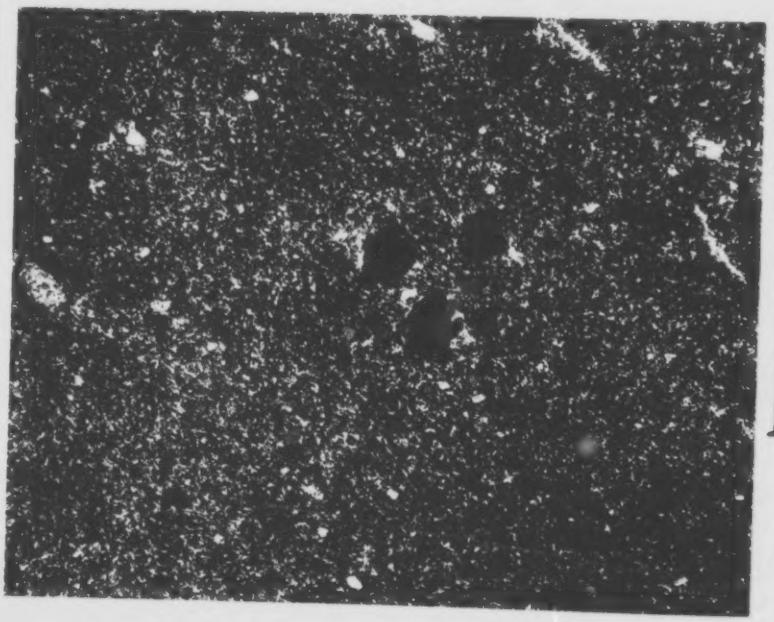


Fig. 1
Conrads Prism

Meta-argillite (spotted slate). Low degree of metamorphic recrystallization.

Optical image
Scale bar = 0.3mm

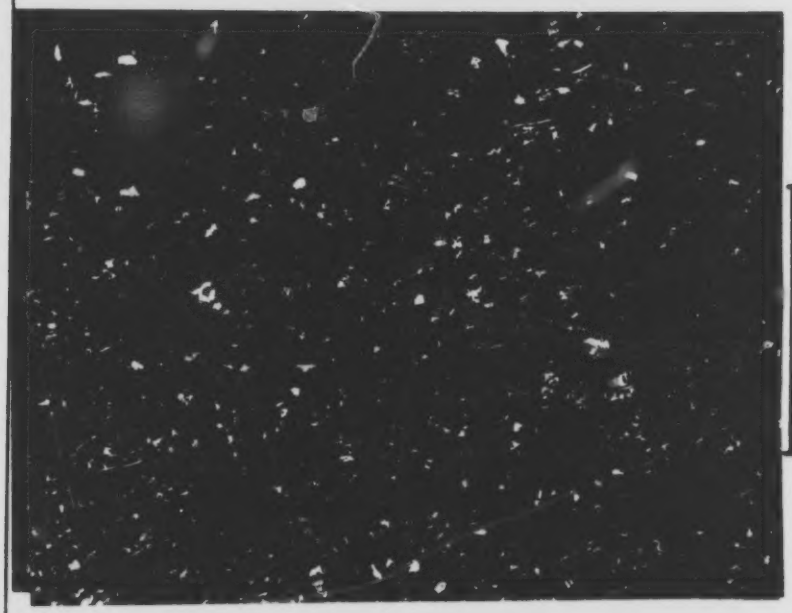


Fig. 2
Conrads Prism

Transition between meta-argillite and meta-greywacke.

Low degree of metamorphic recrystallization.

Optical image
Scale bar = 0.3mm

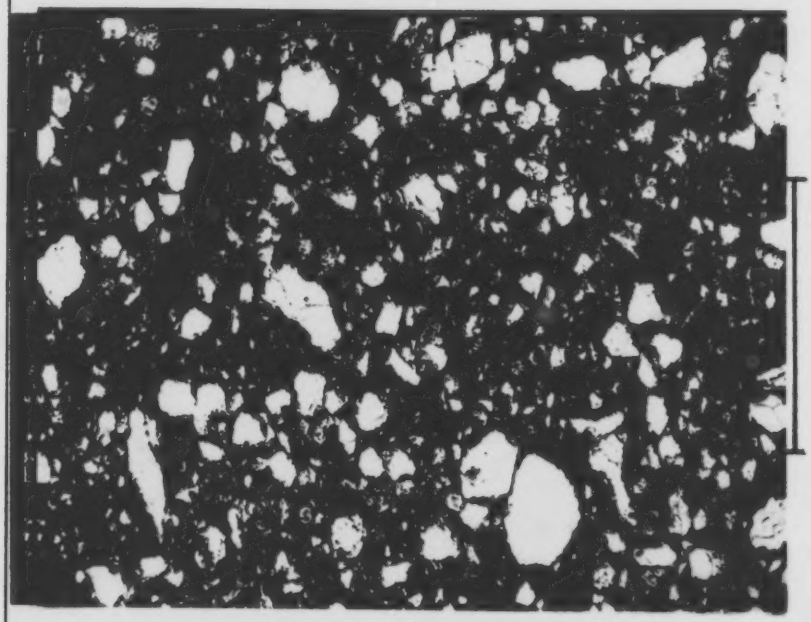


Fig. 3
Conrads Prism

Meta-greywacke. Low degree of metamorphic recrystallization.

Optical image
Scale bar = 0.3mm

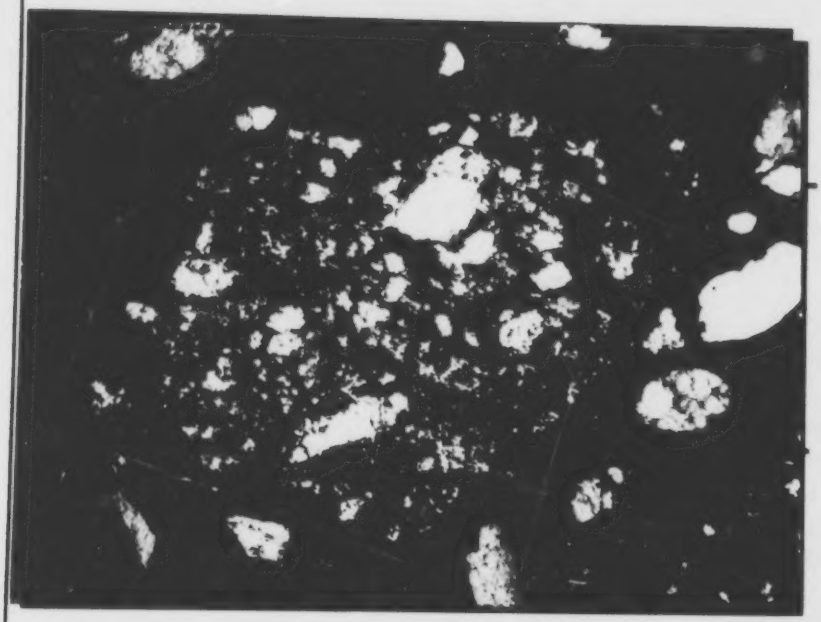


Fig. 4
Yarmouth Prism

Moderately recrystallized meta-greywacke.

Optical image
Scale bar = 0.5mm

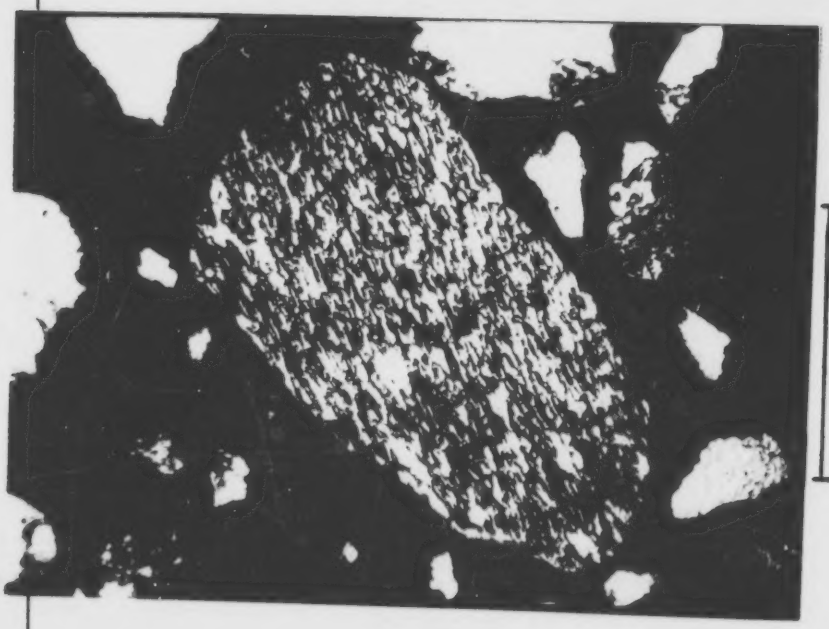


Fig. 5
Yarmouth Prism

Completely recrystallized meta-sediment (andalusite schist).

Optical image
Scale bar = 0.5mm

The content of reactive aggregate particles in the mortar bars was not determined.

The finished surface of the prisms that contain more than 70% reactive aggregate particles (expanding prisms) is covered with white exudations that comprise alkali silica gel and calcium oxides (Fig. 6). The finished surface of both the mortar bars and the prisms containing less than 70% reactive aggregate particles (non-expanding prisms) are clean and exudation free.

Both the aggregate particles and cement paste in all the mortar bars and in expanding prisms are dissected by a network of microfractures that are either filled with alkali silica gels or are free of any precipitates (Fig. 7).

Note:

(1) Fractures filled with gels or other precipitates are believed to have been formed by expansion of the prisms. Empty fractures in aggregate particles may result either from expansion or they may be inherited from the aggregate crushing process.

(2) Different rock types may fracture differently under the same stress conditions (i.e. phyllites are more susceptible to fracturing than massive meta-greywackes due to dense schistosity of the former rocks).

For the reasons indicated above, the incidence of microfracturing is not considered to be an objective expansion rate indicator of the concretes and mortars (concretes free of microfractures are, apparently, not affected by AAR).

Fig. 6
Steed and Evans Prism

White exudations of alkali silica gel and calcium sediments on the surface of concrete prism.

Optical image
Scale bar = 6mm

Fig. 7
Conrads Prism

Network of microfractures dissecting aggregate particles (black lines).

Optical image

It was observed that reaction rims contain alkali-silica gels embedded between particle-forming minerals (Fig. 8). These gels, if not affected by alteration (in fractures dissecting rims) contain more alkalies (combined sodium and potassium) than calcium. The spectrum accompanying Fig. 8 shows relative proportions of silicon, sodium, potassium and calcium, all expressed as relative peak intensities, in alkali silica gel from reaction rims. Hydrogen and oxygen (water in gel) do not show up in the EDS spectra.

Alkali silica gels were also observed in the following locations.

- fractures disecting cement paste (Fig. 9)
- air voids in cement paste
- fractures dissecting aggregate particles (Fig. 10)
- aggregate/cement paste interface (Fig. 11)

Other AAR products observed in both mortar bars and concrete prisms include crystalline alkali silicates (Figs 12, 13 and 14). These are deposited in fractures dissecting aggregate particles or, less frequently, in fractures in cement paste. Crystalline alkali silicates are the dominant precipitates in the non-expanding prisms Only traces of alkali silica gels were observed in these latter prisms.

Accessory amounts of calcium deposits (Fig. 15) observed in both expanding and non-expanding concretes have not been proven to be products of alkali aggregate reactivity.

The concrete bar specimens contain only traces of ettringite (Conrads). The mortar bars appear to be free of ettringite. Note, that relatively abundant ettringite (visual estimate) was observed, by the author of his report, in concrete prisms that contained expanding aggregate from New Brunswick.

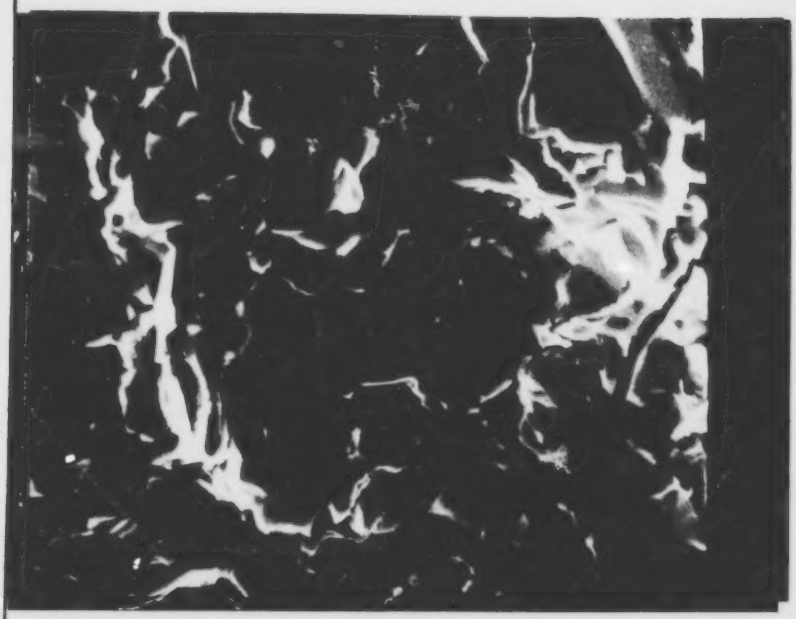
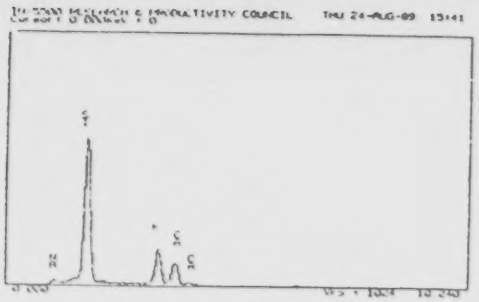


Fig. 8
Chester Prism

Alkali silica gel (fractured, such as arrowed) embedded between mineral grains inside reaction rim. Below is EDS spectrum of the gel.

Electron image
Scale bar = 10 mic.



EDS spectrum of the gel shown in Fig. 8

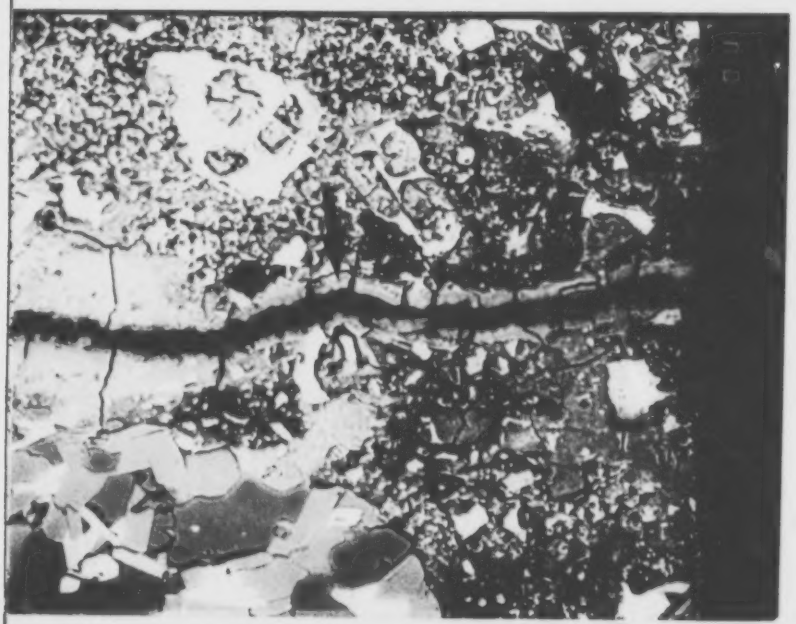


Fig. 9
Yarmouth Mortar Bar

Alkali silica gel (such as arrowed) in fracture dissecting cement paste. Note dehydration cracks in the gel.

Electron image
Scale bar = 100 mic.

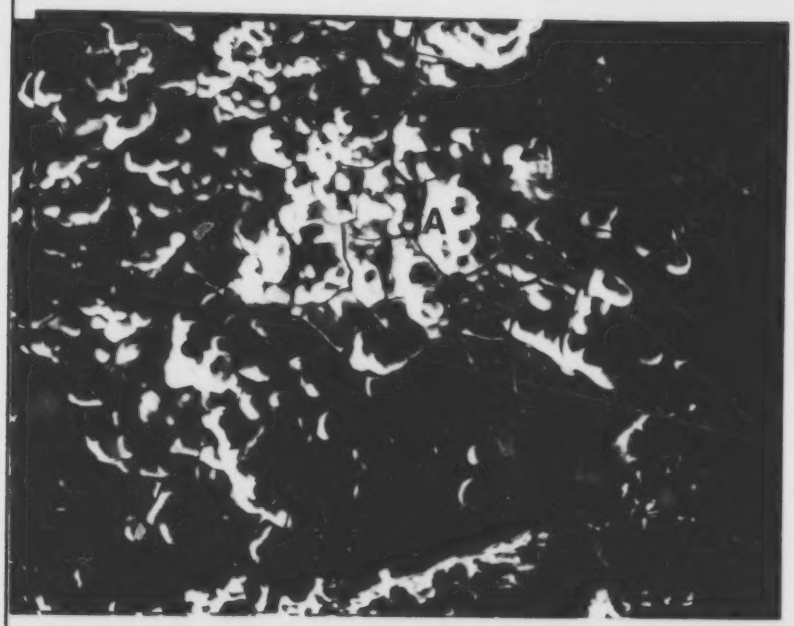


Fig. 10
Steed and Evans Prism

Alkali silica gel (A) in open fracture dissecting aggregate particle (reactive meta-argillite).

Electron image
Scale bar = 100 mic.

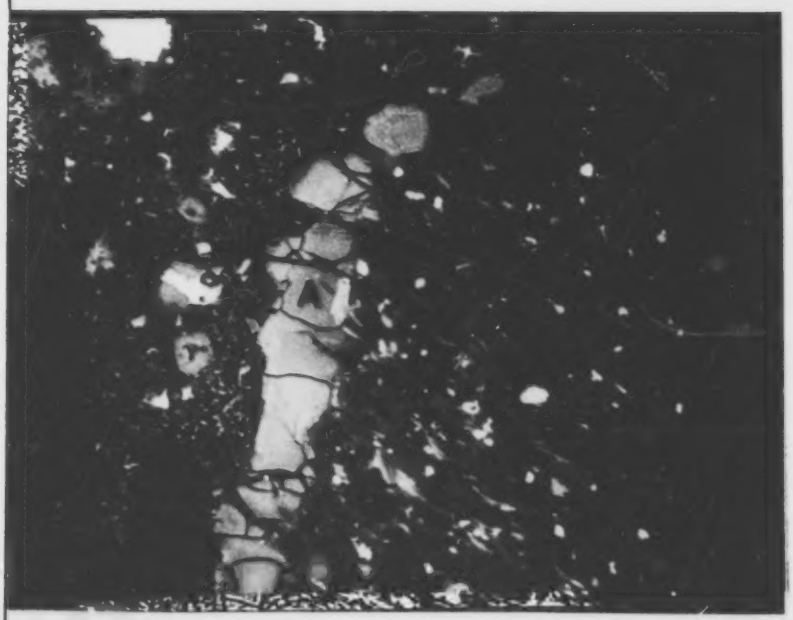


Fig. 11
Conrads Prism

Alkali-silica (A) gel on the interface between reactive meta-greywacke (G) and cement paste (CP).

Electron image
Scale bar = 100 mic.

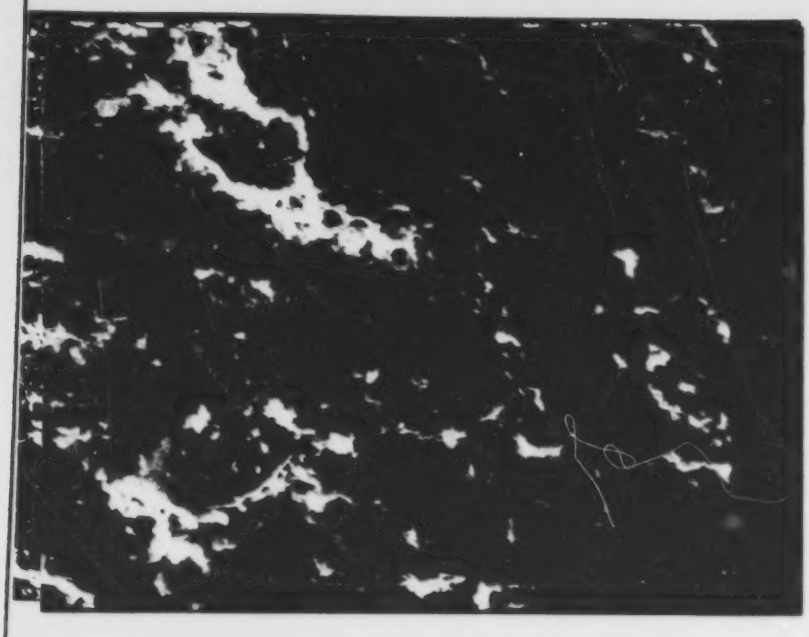


Fig. 12
Conrads Prism

Microcrystalline (?) alkali silicate in fracture dissecting aggregate particle.

Electron image
Scale bar = 10 mic.

Fig. 13
Chester Prism

Crystalline alkali silicate in fracture dissecting aggregate particle.

Electron image
Scale bar = 10mic.

EDS spectrum of the deposit shown in Fig. 13

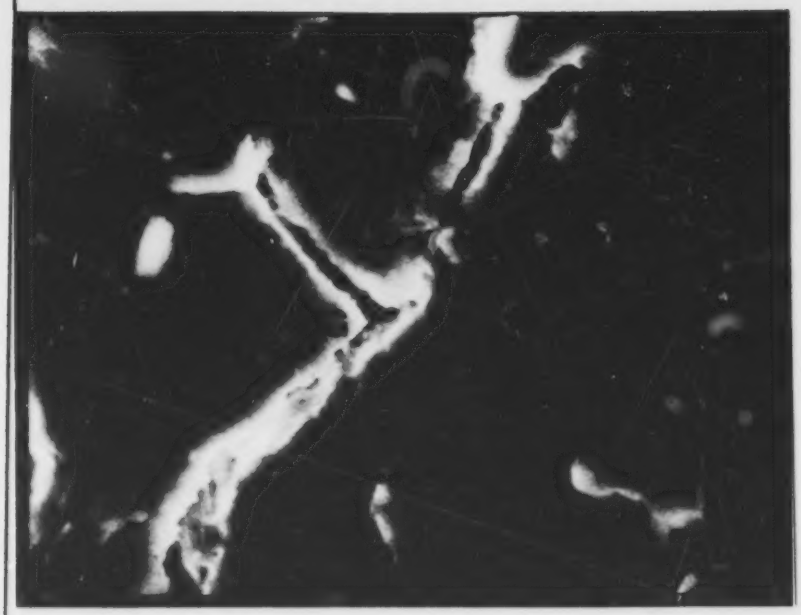
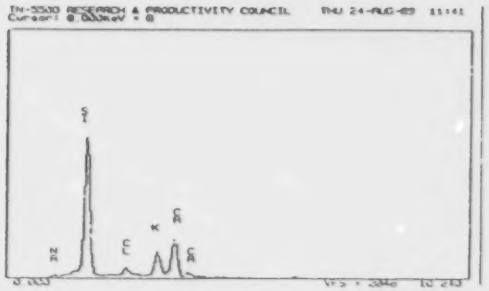


Fig. 14
Chester Prism

Microcrystalline alkali silicate (A) grading into gel (G). Note dehydration cracks in the gel.

Electron image
Scale bar = 10 mic.



EDS spectrum of the deposit shown in Fig. 14

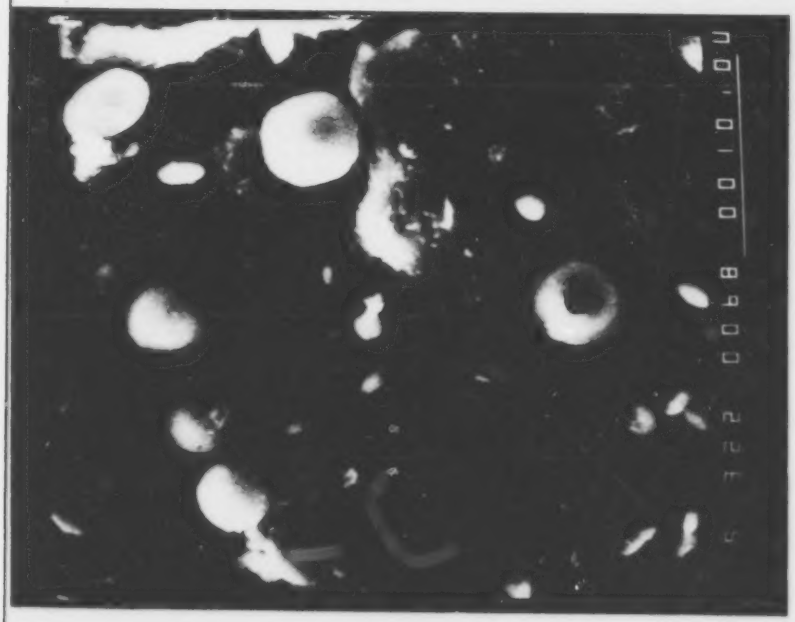


Fig. 15
Conrads Prism

Globules (C) of calcium oxide (hydroxide ?) in fracture dissecting reactive aggregate particle.

Electron image
Scale bar = 10 mic.

4.0 MORTAR BARS

4.1 Barneys (Fig. 16)

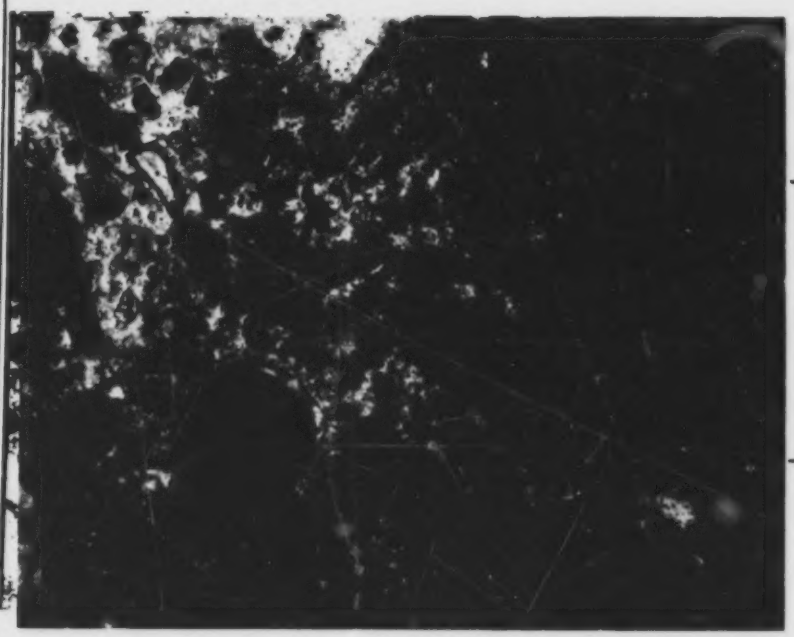


Fig. 16

Dark reaction rims (arrowed) on alkali reactive particles.

Optical image
Scale bar = 0.25mm

Reactive rock types: meta-(argillites, greywackes, tuffs), very fine grained quartzitic argillites and quartzites.

4.2 Meadows (Fig. 17)

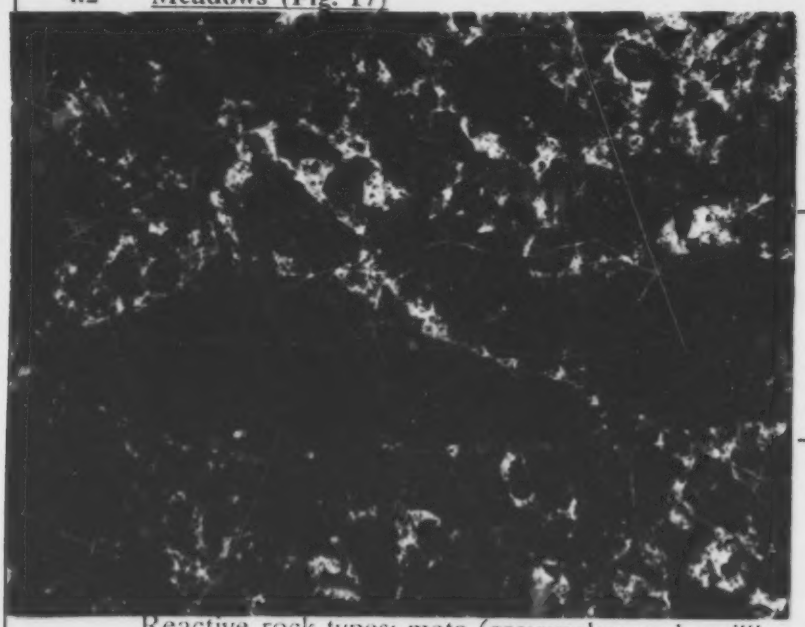


Fig. 17

Dark reaction rims (arrowed) on alkali reactive particles.

Optical image
Scale bar = 3.2mm

Reactive rock types: meta-(greywackes and argillites of volcanic origin, tuffs).

4.3 Yarmouth (Fig. 18)

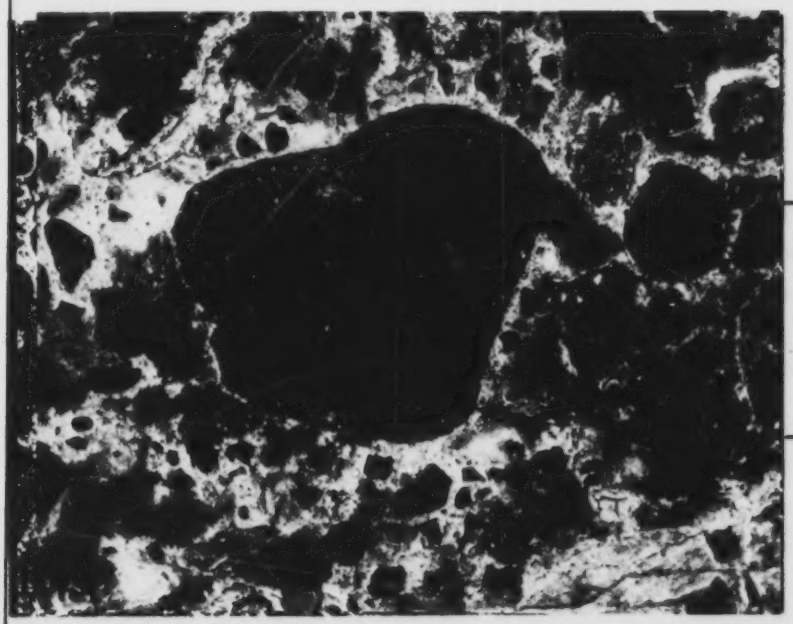


Fig. 18

Dark reaction rims (arrowed)on alkali reactive particles.

Optical image
Scale bar = 2mm

Reactive rock types: meta-(argillites, greywackes, very fine grained quartzites).

5.0 CONCRETE PRISMS

Detailed petrographic descriptions of the rock types identified as alkali reactive in the concrete prisms are to be found in the RPC's report M/88/042 submitted to Jacques Whitford and Associates on November 24, 1988.

Chapter 2, Table 1, this report, contains quantities of reactive aggregate particles in individual prisms. The following are the photomicrographs of reactive and non-reactive aggregate particles in individual prisms.

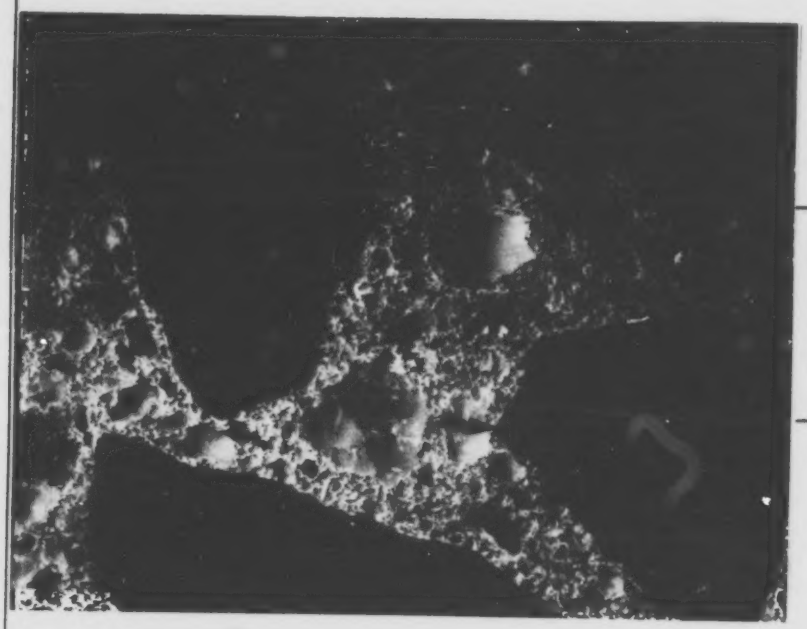


Fig. 19
Chester
Expanding prism

Reaction rims (arrowed) on particles of meta-greywackes.

Optical image
Scale bar = 6.5mm

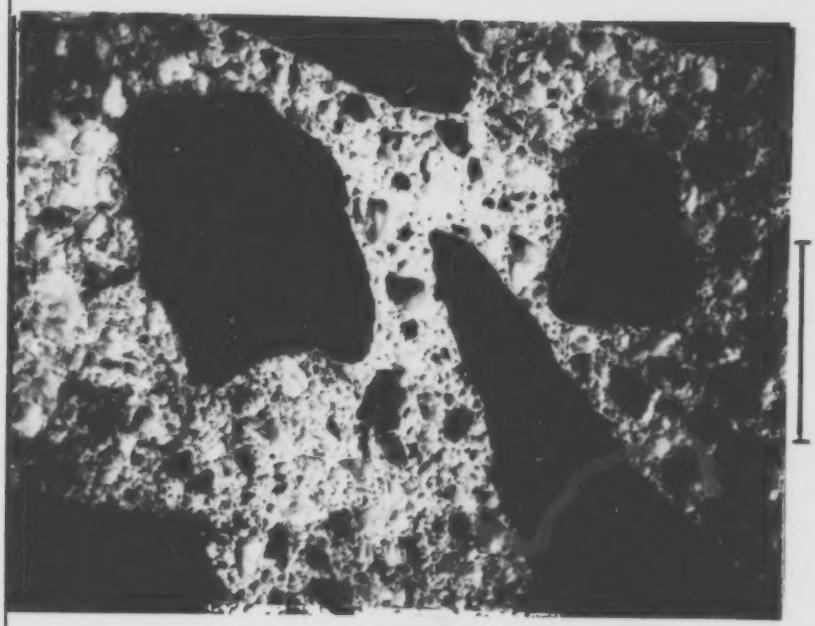


Fig. 20
Conrads
Expanding prism

Reaction rims (arrowed) on particles of meta-argillites (spotted slates).

Optical image
Scale bar = 6.5mm

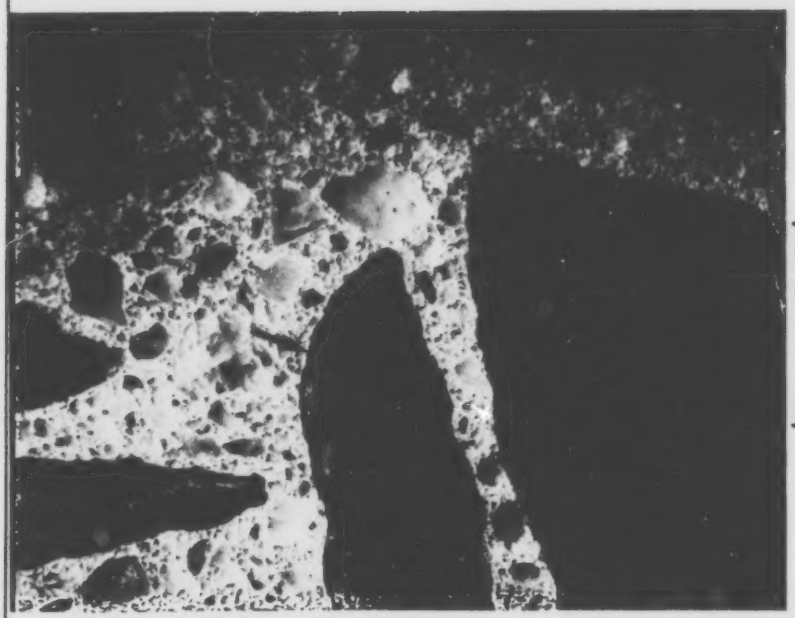


Fig. 21
Rocky Lake
Expanding prism

Reaction rims (arrowed) on a particle of meta-argillite (spotted slates, marked with S) and meta-greywackes. Note fractures (encircled) in aggregate particles

Optical image
Scale bar = 6.5mm

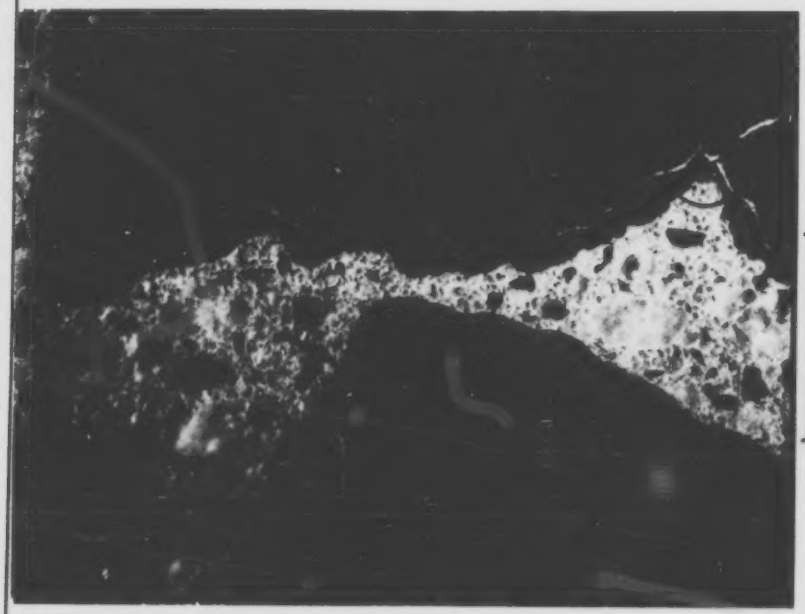


Fig. 22
Steed and Evans
Expanding prism

Reaction rims (arrowed) on particles of meta-greywacke (spotted slates). Note fractures (encircled) filled with alkali silica gel.

Optical image
Scale bar = 6.5mm

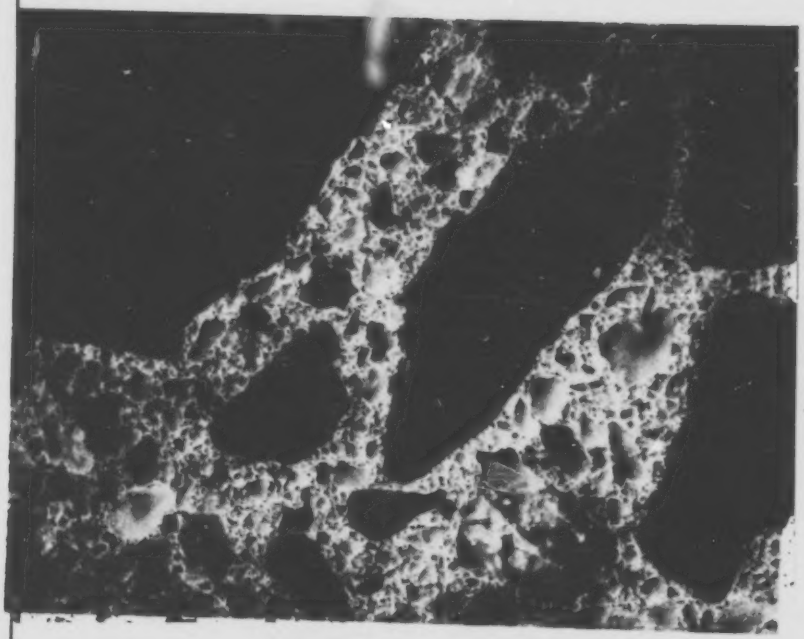


Fig. 23
Gateway
Non-expanding prism

Note absence of reaction rims on particles of meta-greywacke.

Optical image
Scale bar = 6.5mm

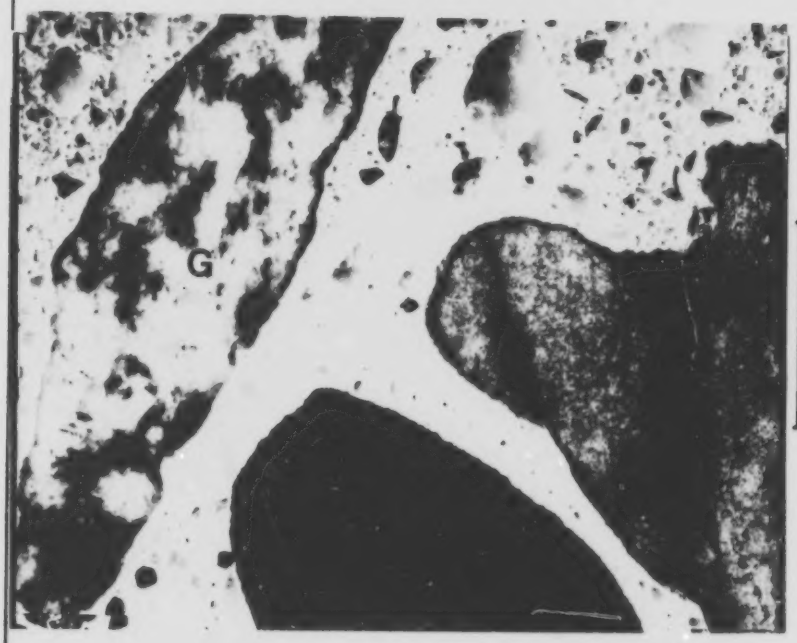


Fig. 24
Yarmouth
Non-expanding prism

Note the absence of reaction rims on particles of granite (G) and completely recrystallizedmeta-greywacke (S-schist). Also note reaction rim on a particle of reactive mata- greywacke and a fracture (encircled) filled with alkali silica gel.

Optical image
Scale bar = 6.5mm

AUTHORIZATION

DEPARTMENT: MINERALS AND FUEL TECHNOLOGY

PROJECT TITLE: "Petrographic Examination of Six Concrete Prisms and Three Mortar Bars"

PROJECT NUMBER: 08200113/1 & 2 NUMBER PROPOSAL

REPORT M/90/07

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